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A LOOK AHEAD[1]

WE have come to an important milestone in the development of an organized effort to promote the advancement of chemistry in America. Fifty years have passed since the American Chemical Society was founded. Under the inspiration of one of the greatest heroes of science, a few chemists who had come together at Northumberland to honor Priestley's memory and the discovery of oxygen conceived a close association of those who had caught some of the spirit of the great experimenter, and shortly after the society was established in New York. No fitter occasion can be conceived for the birth of an idea that grew into a power for so much good.

The development of chemistry in this country was slow at the start. The new nation had to see to its material advancement. It had unlimited natural resources and its rapidly growing population, made up of those seeing freedom and opportunity, had to be housed, fed and clothed and given facilities for communication and transportation. As a result the best brains were devoted to supplying these necessities. It is only in recent years—in the memory of many of us—that the pursuit of chemistry as a life work has appealed. The young man, fifty years ago, was compelled to go to Europe to prepare himself for a scientific career; and it is only comparatively recently that a wise adviser has been able to emphasize the advantages of study at home.

But the last quarter century has seen in America a steady growth of chemistry, and the record of the last decade can not anywhere be surpassed. The story of these achievements has all been written, and we present it with pride to America and the world.

The American Chemical Society has been an important factor in this development. It has been and will be, in an increasing measure, a stimulus to further advance. Through its publications and its organization that brings together men of kindred interests, it makes possible the kind of cooperation that means success. Its efforts to educate the people to an appreciation of the importance of chemistry in the public welfare are becoming more and more successful. The value of a flourishing chemical industry in times of peace and its necessity as a means of defense in times of war are being brought home

[1] Address of the president of the American Chemical Society, given at the anniversary meeting, Philadelphia, September 6, 1926.

to those of thoughtful minds who make our laws. As we review the past and examine the present we are gratified.

While it is well to stop to look back, it is more inspiring to look ahead. History is the story of past actions; it is knowledge. It can become more only when it is interpreted—when it becomes the background for advance. We should think not of the glory of history but its lessons. This fact is largely overlooked in the study of political history. We are content with the facts and fail to see their significance. The scientist should study history in a different way. In the light of the past he should be able to control events so that the history of the future is more to his liking. The causes that have led to the great advance in the chemical industries of this country in the last few years should be studied, and those who make the laws under which industry thrives or dies should be taught this bit of scientific history so well that they will continue to act for the upbuilding of an industry so vital to the welfare of the people.

The wise look ahead even when taking stock. Several of the divisions of the society are taking this anniversary as an occasion to formulate the problems of the immediate future in their own fields. Such formulation is the first step toward solution; it makes advance more certain.

I have been tempted to bring here some random thoughts concerning what lies just ahead in chemistry. But the rôle of a prophet is seldom a happy one, and real prophets have always been rare. Prophecy based on human behavior is not difficult. Human passions are about the same as in Adam's day. Civilization has taught us to clothe them, even to repress them. But given a situation with defined moral or social aspects and it is not difficult to prophesy what will happen when the controlling forces start into play. It takes no unusual prophetic gift, for example, to foretell another great world war.

But in science it is different. Now and then a great discovery is made that changes completely the trend of affairs. It is true that given this new fact we can bring to bear upon it our knowledge of the past and, with the aid of logic and imagination, look into the future. When Faraday had discovered the relationship between electricity and magnetism—perhaps the most far-reaching scientific discovery ever made, in its effect upon civilization—it was possible to conceive of what would follow as the result of the combination of the new fact with accumulated knowledge. It did not require the gift of a prophet for Faraday to reply to Gladstone, when asked what was the use of it all, that some day the government would be able to tax it.

The scientific imagination must start with some definite germ or stimulus. Pure imagination is rare—the gift of the real poet. Poetry or religion can see the communication of soul with soul through space—science can not. But given the electrical waves of Hertz, discovered in an attempt to test certain mathematical calculations, and a third-rate prophet with a modicum of optimism could foretell wireless communication.

It is very profitable to stop once in a while to review what has been accomplished and to formulate the problems of the immediate future. It may be a source of amusement only to go a step farther and with the use of the imagination picture the possible development of the newer discoveries. The summing up of the nitrogen situation by Sir William Crookes, at a meeting of the British Association for the Advancement of Science, and his look ahead in regard to the world's need of nitrates to fertilize the soil in the production of an adequate food supply, gave an impetus to the experimental study of the production of nitric acid from the air. The work of the chemist solved the problem long before the world was face to face with the starvation predicted by pessimists as the result of the exhaustion of what was considered the most important of natural resources to the welfare of mankind.

This triumph gives us courage to face the future. The economist without imagination and a knowledge of what science has done is now turning a gloomy face toward the day when we shall have used up our supplies of petroleum. And when the world is told that the chemist will find a way out, editorial writers point out that scientists are obsessed with an overconfidence in their powers and that the new synthetic age predicted will result in taking all the poetry out of life.

But lack of imagination is not limited to the uninformed. Even some chemists with a knowledge of what their science has done are unable to see ahead a transformed world and look with a sort of pity on those whose vision pictures such marvels as the future utilization of the energy tied up in the atom.

The recent conferences at Williamstown have brought to the attention of thoughtful people the direct bearing of chemistry on world problems—both economic and social. Experts have told what has been done and what lies just ahead. The problems have been formulated, and when the time comes for a new appraisal of the rôle of chemistry in advancing civilization, it will be found that the problems have been solved.

What I have planned to bring to your attention has not been considered from the point of view which was emphasized at the recent sessions of the Institute

of Politics. At these conferences were formulated the future demands of a rapidly growing population for more power to do the world's work, for a more economical use of natural resources, for a largely increased food supply, for a better understanding of nutrition and for a reduction of the economic waste of preventable sickness and death.

I prefer to try to foresee what may reasonably be expected as the result of the future labors of those whose delight it is to question nature, irrespective of the immediate practical value of the knowledge gained.

The last twenty-five years have yielded an astounding knowledge of the nature of the chemist's unit of matter—the atom; and the next quarter century, in my judgment, will see the development of a chemistry of the atom comparable with our present knowledge of the chemistry of molecules. We have learned how to dissect molecules into their constituent atoms, how to bring the latter into new combinations with the result that new substances are formed. A chemist knows how to get hydrogen and oxygen out of water, nitrogen from the air and carbon from coal and with these elementary atoms build up a beautiful dye, an efficient drug, an active poison or a valuable food. He can use his atoms to develop energy to drive his machines. The atoms have been his plaything—his building blocks—and he knows how to play the game.

But he will not be long content with atoms as his smallest blocks. He is now just beginning to learn how to dissect them. Is it unreasonable to prophesy that some of us here may see the day when it will be possible to tear apart the constituents of which the atom is composed and build up from these parts any desired atom at will?

A glimpse into the past may give the doubtful courage to be optimistic. I can recall the day when the scientist's knowledge of the nature of the atom was entirely hypothetical. Even a belief in its very existence required an element of faith. A few observations were made, apparently unrelated, which were seen, however, by thoughtful men to lead to a way to study the atom itself. An attempt to weigh nitrogen with a high degree of accuracy led to anomalous results that had to be explained; the observation that a wire heated to incandescence in an electric light bulb produced a characteristic glow demanded further study, and the striking fact that certain minerals sent off mysterious rays that could penetrate opaque materials and affect a photographic plate set many at work to study the phenomenon. And what has followed from the work inspired by these discoveries? We can now count atoms, one by one; we can even make an atom flash a light or ring a bell to show when it passes. We know that atoms carry electricity and we can determine experimentally the exact amount of the charge. We have been able to prove that the atom is a complex framework built of positive and negative electricity.

Means have been found to tear to pieces complex atoms and get simpler units, which prove to be what we have looked upon as the atoms of other elements. With such a record of achievement accomplished since many of us entered upon a life work, who would dare to oppose the view that before long we shall be able to work with atoms as we do now with molecules. Whether or not mercury has been already changed into gold or gold into mercury lacks importance in the light of coming events. When the imaginings of the past—mere dreams—have come true, we feel a confidence in a future based on such achievements. Some years ago I heard Mr. Elihu Thomson prophesy that before long the technical applications of electricity would resolve themselves into electron engineering. Some smiled then who would not do so to-day.

The atoms are a storehouse of energy that make coal, petroleum and waterfalls sink into insignificance as the means to do the mechanical work of the world. I hold it is not foolhardy to refuse to worry about the consumption of natural resources or to look to the future with confidence that science will always keep ahead of the needs of the world.

Our present knowledge tells us that each individual atom resembles a solar system. Charges of negative electricity—the electrons—revolve at comparatively great distances around a central nucleus composed of positive and negative charges. Until recently the electron has been the smallest unit recognized. But a new era is dawning. Sir Joseph Thompson, who has been a leader in this field of investigation, now proposes a new hypothesis—even the electron is complex; it is itself a solar system of a new order of magnitude. This hypothesis makes it possible to correlate the older with the newer views as to the manner in which radiant energy is transported from place to place. What lies ahead as the result of the experimental study of this new hypothesis no one can foretell. But we can be sure that the developments ahead will be a most important factor in moulding our future civilization.

It is perhaps worth while to picture some of the consequences of the discovery of a method to dissect the atom and to put together the parts into other arrangements. This means practical transmutation of the elements. When this is accomplished it will be possible not only to make gold out of mercury but any metal desired. It is evident that such a result would destroy our present system of values. An economic upheaval would force upon the world a change

from the present unsatisfactory system based upon gold to a more rational one based on something more fundamental—perhaps the value of a man's labor or on necessary commodities. Whatever the result, we would see new standards set up which would change society in such a way that a more equable distribution of wealth would follow. Property rights in natural resources would disappear. A family could not live for generations in affluence and produce nothing, as the result of the purchase by a forefather of a copper mine when the demand for the metal had not developed. It is impossible to conceive of the extent of the social revolution that would follow practical transmutation of the elements.

We know that the atoms consist of unthinkable amounts of bound-up energy. They are like a jack-in-the-box. When we learn how to touch the button the energy will spring out and we can use it. There will then be no underground slaves and no coal barons. A limitless supply of energy will make over the world. Every man will have time to taste of the joys of life.

I hold that these views are not phantasy. Contrast life a century ago and to-day. Study the effects of great discoveries and the inventions based upon them. What were the effects of the steam engine, the internal combustion engine and the dynamo? When the world learned how to use heat as a source of energy a new epoch in civilization was marked out. When heat was the only form of usable energy to bring about transformations in matter a great chemistry was built up. With the discovery of electricity and the methods to develop and use it, a second epoch in civilization was created and a new chemistry was born. Substances considered elementary were found to be complex and the science made life easier and happier.

We are now beginning to study the effects of a new kind of energy on matter—the energy tied up in the electron and the atom. We scientists know that energy has two factors—quantity and intensity—and that the latter factor is all important in bringing about changes in matter. We are beginning to learn how to obtain and use energy with a high intensity factor, and the result will be again a new chemistry and a new world to live in.

This new type of energy—an electric charge travelling almost inconceivably fast—can do wonderful things that can not be accomplished by less intense forms. A whole new field in chemistry lies before us for study. When I saw not long ago in the laboratory of Dr. S. C. Lind a tiny drop of a colorless oil that had been formed from methane—the chief constituent of natural gas—as the result of the action of this form of energy upon it, I felt a new era in chemistry had dawned. That droplet meant a supply of combustible liquid to run our automobiles when petroleum is exhausted. We can make methane from carbon and hydrogen when the supply of natural gas fails us. The sun will always be able to convert carbon dioxide into a form from which we can get back carbon. The pessimistic critic will declare this is all impossible. He will say that radium was used to get the kind of energy to bring about the transformation and that there is not enough radium in the world if we could afford to pay the high price for the energy needed. But radium is not necessary. The work of Coolidge shows that we can get this kind of energy from an X-ray tube. But again the rejoinder is that this kind of energy is too expensive to use. Such a critic limits the achievements of the future to the application of known knowledge and can not see that the past has proven that new knowledge furnishes the means for advance. When electricity from a primary battery was first converted into light, who would have conceived of its being ever cheap enough to be used to draw heavy freight trains over mountains?

The study of the behavior of matter under the action of energy with a high intensity factor will lead to a new chemistry. The ground has only been broken in the investigation of action of sunlight, ultraviolet light and X-rays. And now the highly penetrating rays studied by Millikan furnish an opportunity for the discovery of startling facts. The utilization of the radiant energy supplied free and in unlimited amounts will follow further study in this field. At present we rely upon the slow-going processes of nature to convert the waste carbon dioxide of the air into the cereal foods so necessary for living things. Bailey has shown that ultraviolet light will convert formaldehyde into a sugar. And since formaldehyde can be made from the products formed when coal is heated with steam, it is possible to see ahead the synthesis of foods without the slow process of passing through the vegetable kingdom.

Turning now to a consideration of the molecule, the next step up in the complexity of matter, it is possible to speak with more confidence. We have had a chemistry of molecules for over two centuries, whereas the chemistry of the atom is still an infant. The last half century has yielded an astounding amount of knowledge in regard to the architecture of the units of which individual substances are built up. Structural organic chemistry holds the first place among the intellectual triumphs in this field of science. It is possible to pick to pieces a complex natural substance in such a way that each operation gives us information as to how the atoms are united. And when the work is finished we can construct a model which shows how the many atoms present are linked

one with the other. But we can go farther. Guided by the model we can, like the architect, gather together the pieces required from many sources and fit them together in such a way that our finished product is identical with the substance from which the model was constructed. Nature furnishes us with a blue coloring matter which is the highly prized and useful dye indigo. The detailed study of the substance led to the drawing of the plan of the complex molecule; and later, with this as a guide, it was found possible to construct from simpler and readily obtainable building material the same kind of molecules elaborated in the plant.

Not content with copying natural products, the chemist has made hundreds of thousands of compounds, many of which have been found to be useful. Future developments in synthetic organic chemistry will add much to the health and happiness of the world. We have many trained architects and builders for the work, and the technique is well understood. In the past many chemists have contented themselves with applying the methods to build up thousands of compounds without any thought as to value of the finished product. The game has been such a fascinating one, and in most cases so easy to play, that sufficient satisfaction came from merely building the new house. But this point of view has largely disappeared. The incentive now is the need for a substance to be used for a particular purpose. We follow the architect again. He designs a building to be used for a definite purpose—a schoolhouse, a church, a factory. There may be need for a substance with a particular color, odor or other desirable property; a liquid having a definite boiling point and volatility may be required for the preparation of lacquers or varnishes; or a substance may be sought to combat a particular disease. The solution of such problems as these is becoming an incentive for work in synthetic organic chemistry. Another important driving force is the desire to prepare from cheap raw materials important industrial products whose future applications will be so extensive that the present source of supply will be inadequate.

The processes to be used in this work are drawn from the work already accomplished. And while some chemists are solving these problems, others will be busy in finding new and better ways of laying the bricks.

Recalling the achievements of the past one can boldly prophesy future triumphs. As an example, let us consider but one field in which synthetic organic chemistry will prove itself to be perhaps the most potent factor of all those that are working toward the advancement of civilization and the peace of the world. I refer to the use of chemical compounds in combating disease and, as a result, prolonging life—the modern science of chemotherapy.

Some of us have heard discussed recently at Williamstown the astounding loss of efficiency of the human race that results from preventable sickness and death. An eminent statistician whose business it is to study such problems for a life insurance company with world-wide activities evaluated the loss from data based on a definite mathematical knowledge of the facts. The figures were appalling, and considered along with the fact that the causes of the great wars in modern times can be traced back to economic pressure in one form or another, but one conclusion can be drawn: the world must focus its attention upon this, the greatest of world problems.

We heard, too, at Williamstown, what chemistry has done to combat disease. Dr. Loewenhart told an inspiring story. Sleeping sickness, hookworm disease, syphilis and allied scourges have been taking a toll of millions, but synthetic organic chemistry has produced substances that are conquering these terrors. A start only has been made. Malaria, spread in the most fruitful parts of the globe, is incapacitating and destroying millions and we have used but one drug—quinine—with which to fight it.

It is the aim of chemotherapy to build up substances, not supplied by nature, which have such physical and chemical properties that they destroy the organisms which cause disease. This great new science has been woefully neglected in this country. The Rockefeller Foundation that has spent millions of dollars in promoting world health is content to make use of known facts and has done nothing toward increasing knowledge in this field.

Some broad-minded philanthropist with vision will see the opportunity for world service and endow an institution in which synthetic organic chemists, pharmacologists and doctors skilled in chemical medicine will cooperate in solving the greatest problem before the world to-day. As knowledge grows, the curative effects of antitoxins and other complex organic substances developed in the body will be traced to specific organic molecules capable of synthesis in the laboratory. Disease after disease will be conquered and a new era will dawn.

I have just sketched a few important applications of our accumulated knowledge of the molecule. But it is also important to stress the fact that while we have gone far in interpreting molecular architecture. much remains to be done. We know a great deal about the relative positions of the different kinds of building stones that make up the whole, but are densely ignorant as to the forces that bind them together. When we come to consider their energy relationship our analogy between a molecule and a build-

ing made up of many parts fails. The parts of which the molecule is made up—the atoms—attract one another with different degrees of affinity and forces are thereby set up that come into play when an attempt is made to alter the molecule in any way. It is comparatively recently that inquiry has been turned toward this problem in organic chemistry. Attention has been centered largely on the changes in matter that take place when one kind of molecule is changed into another kind. The future will see a great development in our knowledge of the energy transformations in chemical change. We shall be able to evaluate mathematically, in definite units, the forces that come into play when transformations between organic molecules take part.

In fifty years the graphic formula of an organic compound will be far different from the crude pictures of to-day. It will apparently be very complicated, but to one who understands the significance of the symbols used it will be simplicity itself and will indicate a wealth of knowledge that will make it possible for the adept to handle the molecule with certainty as to the results.

We have much to learn as to how molecules interact one with another. In very many cases we know what is the result, but we do not know how the forces come into play—what we call the mechanism of the reaction. A start in this difficult field has been made and much lies just ahead. It is my opinion that the time has come for an intensive study of the molecule from this point of view.

Many of the processes now used more or less empirically will be understood, and we shall be able to apply them with mathematical precision. Catalysis will be used with an understanding of its laws as we use chemical equilibrium to-day.

I have limited what I have said up to this point to a consideration of what future work may reveal as the result of the intensive study of atoms and molecules, and I have noted briefly a few possible applications of the new facts that will undoubtedly be discovered. It would be possible to look ahead from another point of view and see other things that are in the immediate foreground. One could first look back on the highly specialized branches of chemistry, see what has been done and the present trend of inquiry and then project his vision into the future. But there is not time for such a fascinating survey and exercise of the imagination.

The industrial division of the society will devote a part of its time at this meeting to such considerations, which I believe will be helpful in pointing the way to future advances. I found it an interesting task to examine the possibilities that lie ahead in the field of petroleum chemistry, and, as a result, came face to face with many problems the solution of which will be sought through personal work and influence.

We have many young investigators who are looking for worlds to conquer. Their point of view is not yet broad enough for them to be able to settle upon some research problem, capable of solution in a reasonable time, the results of which will be a definite, worthwhile advance in knowledge. Any agency that can be helpful in directing research in this way should be encouraged. The division of chemistry and chemical technology of the National Research Council has made it a part of its business to advise in regard to problems for research, and I am sure that many suggestions will be found in the addresses by the experts who are to review the various activities in industrial chemistry. It is to be hoped that the workers in pure science will soon stop to look ahead in their several fields and outline as specifically as possible problems worthy of immediate study.

At this time in the history of the society we are looking back on the growth of chemical knowledge in the last fifty years and on what chemistry has done for the world. We must not forget that all the results of which we are proud are based on painstaking research. If we are to go ahead it will be only through research that the desired aim will be reached. The appreciation of the value of research is rapidly growing in this country, and the American Chemical Society has taken no small part in bringing about this satisfactory state of affairs. It has been a hard fight. With the financial control of our industries largely in the hands of those who know nothing of science or its uses, it has been difficult to obtain the support for research that it needs. When the attitude of certain executives is to oppose research on the ground that anything new might disturb the present state of affairs—might even make their expensive plants obsolete—it is easy to see why we do not hold first place in developing new and important industries. We have been building largely on the fundamental work of others. But this condition is slowly changing. It is a fortunate thing for the chemical industry of this country that trained chemists are working their way up to positions of responsibility that control financial policy. Such men know that research pays even when the company itself must meet the bills.

There are at present several agencies at work that will lead to an increase in the scientific productivity of this country in the immediate future.

Research from the standpoint of pure science—the basis of all advance—will receive a stimulus from the great fund now being collected by the National Academy of Sciences through the activities of a committee of which Mr. Herbert Hoover is chairman. With two million dollars a year for ten years to cover the cost

of research in all fields of pure science, such a start will be made that assistance in the future will be assured.

The growing demand of industry for men to improve old processes and devise new ones through research is attracting many young men of brains to that field. Our universities are overtaxed with graduate students in science; and each one, under careful supervision, is extending the boundaries of knowledge in learning how to solve scientific problems.

The development of research of this type is assured, but there is another kind, equally important, if the industries based upon chemistry are to progress. There is an immediate need for the intensive study from a fundamental point of view of the chemistry underlying these industries. It can not be expected that a single organization will finance such work, the results of which should be available to the entire industry. In my judgment, cooperative effort will be the solution of the problem. We have seen that England, after the war, came to this conclusion; and the laboratories set up by the more important industries are doing the kind of work that will help England hold its position in the industrial world.

We are only now learning in this country the value of cooperation in industry. Where it has been tried it has succeeded. It is a different type of cooperation that has made fruit-growing so profitable in the west. The farmers of the middle west will stop their complaints when they have learned their lesson. The day of the individual and the small business organization is passing. We are learning that trusts are not entirely a menace. The individual units in great industries will find some day that they have a common ground on which they can meet and problems which they can attack in common.

Suppose a large industry—like that devoted to the utilization of rubber—should establish a research laboratory to investigate problems fundamental to the industry and for the study of which no provision can now be made in a single organization. It is easy to see that great good would come from such cooperation. Would not a cheap and reliable source of synthetic rubber be a boon to the industry as a whole? Is any single company willing to finance such an expensive research, even though the prize if won is so valuable? But if the work were to be undertaken by cooperative effort each stake in the gamble would be so small it would be a very minor item in the budget.

There is still a third type of industrial research that is growing rapidly, as it has already shown that it pays. This has to do with the detailed study of the processes used by individual companies. There is, however, a chance for improvement here. If we are to utilize the results of research in pure chemistry and in so doing make them of service to the world, we must develop new processes based on these results. The United States lags far behind in this field. Some progressive industries have seen the significance of certain phases of research in pure science and have built up industrial processes of great economic value. The application of catalytic action has added to the world's wealth.

Pure science has told us that carbon monoxide and hydrogen can be converted into formaldehyde and methyl alcohol, but others had the initiative to do the work upon which a great industry will be founded.

I am optimistic about the future of industry from this point of view. We have seen many examples and have learned the lesson. Our chemical industries are growing and producing wealth. We are getting to be a rich nation and those who have the money want to see it work and will in time learn that chemistry can produce gold in more ways than one. The financial backing will be at hand; we have but to teach the people to wait for profits.

As a result of a look ahead I am filled with confidence in the future. I see in the next half century a great development in chemistry in the world, and especially in this country, where the conditions are most favorable. I see our knowledge of matter extended so broadly that what we know to-day is but the foreground of an impressive picture. And I see an unparalleled utilization of chemical knowledge for the physical, esthetic and economic welfare of man. And when through the efforts of chemists the world has more of good health, and every one more leisure to get to know his fellows, to travel, to enjoy the best in life, the day will come when the world will be a better place in which to live and international good feeling will prevail.

James F. Norris

Massachusetts Institute of Technology

JOSEPH PRIESTLEY[1]

The intelligent world marvels and admires the ubiquitous manifestations and astounding properties of at least one elemental body, *viz.*, oxygen. Its discoverer—from the humble walks of life—a simple-minded pedagogue—an earnest, disenthralled Calvinist in religious adherence—but happier and most active as a dissenting clergyman, as well as a dissenting subject as to forms of government prevalent in the land of his nativity—was not, on the other hand, so universally admired and appreciated, indeed, was despised, hated and persecuted by untold multi-

[1] Priestley Lecture given at the anniversary meeting of the American Chemical Society after the Priestley Medal had been conferred on Dr. Edgar F. Smith.

tudes of his countrymen, so that in 1794 and for years later, at intervals, he might have been seen walking the streets you all have trodden on your perambulations through this city, in this thanksgiving period represented in the Sesquicentennial celebration of our loved republic. Here, in due course, the discoverer of oxygen gathered with our earliest scientists. In a modest, unattractive structure on Fifth Street, midway between Chestnut and Walnut streets, bearing the name "Anatomical Museum," he witnessed on several occasions experimental demonstrations of the non-existence of that fatuous, evanescent non-entity—phlogiston, which had so beclouded and befuddled his intellect that profound observations and epoch-making discoveries absolutely escaped his discerning eye and judgment.

In the now ancient abode of the American Philosophical Society—diagonally across the way from the Anatomical Museum—he mingled with the membership of that august body and gave expression at times to his views on topics under discussion; pleasing by his urbanity, by the display of broad scholarship, by his genius, by his scientific interests, to such a degree that some years subsequently he was obliged to peremptorily decline the use of his name for the presidency of the society.

And, down on North Second Street in the old Baptist church, on a Sunday night during his brief sojourn in the city, he and his loyal companion (Mother Priestley, affectionately so-called) were to learn that the intolerant, unchristian spirit which had pursued him and his had found its way even to these shores, for upon their entrance in the church, as they passed down its main aisle to a seat, the pastor, a learned doctor of divinity, espying them, arose and raising his eyes and hands toward heaven, exclaimed in loud tones:

> See, O Lamb of God, how they would pluck
> Thee from Thy throne!

What could have been the thoughts of that aged, god-fearing couple from beyond the sea!

The divine who thus sought to humiliate them chanced to be a member of the American Philosophical Society. In the course of a few days there came to him from the secretary of the society a brief communication demanding an immediate apology for his unjustifiable conduct or expulsion from membership would ensue. The apology was made.

At the southwest corner of 4th and Locust streets is a handsome colonial home. There resided the eminent Caspar Wistar. There, quite often, congregated the first men of the city—first in national affairs, in commerce, in the learned professions, in science and in literature. Frequently, he of whom I speak could have been observed there. He was happy in the company of dignified and brilliant men. He loved to be with them. He was deeply appreciated and eagerly sought after because of his winning ways, his tolerance and liberality. He was also moderately convivial, though he said that one glass of wine at dinner was enough for an old man, but he did not prescribe his own practice as a universal rule.

Would that you all might read the fascinating little novel by Harriet Martineau, entitled "Briery Creek." In it the subject of this sketch appears as the hero.

If you will pass out to 22nd and Chestnut streets, you may there view the splendid home of the First Unitarian Church—there because of the self-sacrificing labors of the isolator of oxygen. He was the founder of his faith—the Unitarian—in this community. His pulpit appearances here were at first in the churches of evangelical communions, but later almost exclusively in the "Greal Hall" of the University of Pennsylvania. This was because gradually there had arisen suspicion of him, engendered mainly by anonymous vitriolic attacks from one bearing the nom de plume "Peter Porcupine," otherwise William Cobbett, an Englishman whose pen, dipped in gall, spared the venerable scientist in no wise. Despite it all, the exponent of experimental endeavor enjoyed the near association of his Reverence, Bishop White, leader of the Anglican faith, John Ewing, dominant in Presbyterian councils, and crafty John Adams, of New England birth and training, who honored the preachings of oxygen's discoverer on all occasions, openly congratulating him upon his broad catholicity and his devotion to the instilling of the highest principles of Christianity.

Such was the one whom, as chemists, we justly revere, and who as frequently described was one

> whose genius, like a star of dazzling resplendance, shines with conspicuous lustre in the galaxy of his brilliant contemporaries—the philosophick Priestley.

But he was more:

(1) A writer, the philanthropy of whose heart never slept.

(2) A metaphysician—truly the first of his age.

(3) A politician who assiduously labored to extend and illustrate those general principles of civil liberty which are happily the foundation of the constitution of his adopted country.

(4) A man who inspired the readers of his generation to *think* and investigate beyond any writer of his day.

Chemists everywhere should read not alone his communications setting forth the discovery of oxygen, but all his scientific publications. The science world of

his day viewed them as epoch-making, for they appeared in splendid translations in all the languages of contemporary Europe.

Then should be read his lectures on oratory and criticism and on general history, as well as his volume on "Perspective," that his profound attention to literature in general, as well as to art, may be noted. However, your thoughtful consideration must be called to another truly remarkable work of Joseph Priestley—further proof of his versatile intellect—a work the fitness of which and the belief in which are to-day evidenced on all sides of us.

Indeed, if the Priestley medallists for the next quarter of a century were each, in turn, to discuss some domain in which our hero has left his imprint, the complete story of his versatility could not be conclusively told.

Ten years before discovering oxygen—that was in 1764—Joseph Priestley wrote an "Essay on a Course of Liberal Education for Civil and Active Life," saying that when he became a tutor in the old Warrington Academy he found

> the far greater part of the students were young gentlemen designed for civil and active life, whereas the course of study, as in all other places of liberal education, was almost entirely adapted to *the learned professions;* and it occurred to me that, besides the lectures which they had been used to attend, other courses might be introduced, which would bring them acquainted with such branches of knowledge as would be of more immediate use to them when they should come into life.

Accordingly, he proceeded to prepare a new curriculum. He was far in advance of his fellow educators, as the "Essay" shows. Brief abstracts from it are these:

> I would recommend as new subjects (1) Civil History and (2) Civil Policy; such as the theory of laws, government, manufactures, commerce . . . and (3) the study of the country's *present constitution and laws* that the student may acquire a more thorough acquaintance with his own country. . . . Time was when scholars might, with a good grace, disclaim all pretensions to any branch of knowledge but what was taught in the universities . . . but those times of revived antiquity have had their use, and are now no more. We are obliged to the learned labours of our forefathers for searching into all the remains of antiquity, and illustrating ancient valuable authors; but their maxims of life will not suit the world as it is at present. . . . The politeness of the times has brought the learned and the unlearned into more familiar intercourse than they had before. They find themselves obliged to converse upon the same topics. The subjects of history, politics, arts, manufacture, commerce, etc., are the general topics of all sensible conversation.

Are not these suggestions modern in their tone and are not our technical schools, our schools of finance and commerce, of administration—products of these visions of Joseph Priestley upon a "Liberal Education"? That printed document to which reference has been made is rich to overflowing in similar thoughts. A pioneer truly was he in education—a profound student—the speeches of his detractors to the contrary notwithstanding.

A few years subsequently he wrote "Remarks on a Proposed Code of Education," and a third and rather lengthy document, possibly influenced thereto by Benjamin Franklin, on "Miscellaneous Observations Relating to Education, more especially as it respects the Conduct of the Mind."

And now—quite recently (*Journal of Educational Research* for May, 1926) has appeared a very interesting and learned article in which the writings of Herbert Spencer and Joseph Priestley are compared—extracts from their publications being printed side by side and closely contrasted. The concluding paragraph of this startling communication reads:

> In their non-Conformist position, their opposition to state control of education, their individualism, their radical attitude on science, their utilitarianism, the two men agree closely. It is not strange that Herbert Spencer should have gone to this intellectual ancestor of his for ideas; but it is singular that the debt should not have been discovered before; and it is note-worthy that the debtor on every occasion fought vigorously in defense of his various claims for priority. Spencer's chief additions to Priestley's eighteenth-century thought were a slashing style and a brilliant faculty for special pleading. Few, if any, other writers on education have attained a great reputation so cheaply; but perhaps fame rarely conforms to the facts.

But I must stop. Another side of this versatile brother chemist has been called up; and when he is properly understood and known, future generations will encircle his name with

> those never-fading wreaths, compared with which the laurels that a Caesar reaps are weeds.

We chemists of America, holding high that name, glory in the privilege of

> doing honour . . . to Priestley, the peerless defender of national freedom in thought and in action; to Priestley the philosophical thinker; to that Priestley who held a foremost place among "the swift runners who hand over the lamp of life," and transmit from one generation to another the fire kindled, in the childhood of the world, at the Promethean altar of science.

EDGAR F. SMITH

JAMES ALEXANDER LYMAN

JAMES ALEXANDER LYMAN, Ph.D., Johns Hopkins, 1892, for seventeen years head of the department of chemistry at Pomona College, Claremont, California,

died suddenly on July 29, 1926, while on a vacation trip at Long Beach, California. His death followed an operation for acute appendicitis.

Dr. Lyman was born in Lee Center, Illinois, October 17, 1866. He was graduated from Beloit College in 1888 and took his master's degree from the same institution in 1891. At the close of his graduate work at Johns Hopkins he was an instructor for one year at the University of Chicago. He then taught chemistry at Portland (Oregon) Academy until he became head of the department of chemistry at Pomona College in 1909.

Dr. Lyman was married in 1897 to Ethel Anna Skinner. He is survived by his wife and three children. His younger and only brother, Dr. George R. Lyman, late dean of the college of agriculture at the University of West Virginia, died recently, thus bringing a double loss to the aged parents who survive them.

Dr. Lyman's special research problems were in the field of sulphonphthaleins and the ethers and esters of p-nitrobenzyl alcohol. He was joint author with William Conger Morgan of two preparatory school text-books, "Chemistry, an Elementary Text-book" and "Chemistry, an Elementary Text-book with Laboratory Manual." He also had nearly completed the manuscript of a text-book of organic chemistry.

Dr. Lyman was a brilliant and inspiring teacher and under his guidance a strong department of chemistry was developed at Pomona College. To his students he was a wise counsellor and a good friend. To those like myself who had the privilege of working with him in the department he was always the soul of kindness and sympathetic understanding. His keen sense of justice and his good judgment, seasoned with a humor which always took the sting out of criticism, made him admired and deeply respected by his students and colleagues and the members of the community in which he held honorable place. He has gone for a time, but his spirit lives in the hearts of the many to whom he has given a helping hand.

EDWARD P. BARTLETT

SCIENTIFIC EVENTS

THE PRESENT STATE OF SCIENTIFIC KNOWLEDGE OF CANCER

AT the close of the conference on cancer held last week at Lake Mohonk, N. Y., more than a hundred specialists from various countries joined in the following statement:

Although the present state of knowledge of cancer is not sufficient to permit of the formulation of such procedures for the suppression of this malady as have been successfully employed for the control of infectious diseases, there is enough well-established fact and sound working opinion concerning the prevention, diagnosis and treatment of cancer to save many lives, if this information is carried properly into effect.

Although the causation of cancer is not completely understood, it may be accepted that for all practical purposes cancer is not to be looked upon as contagious or infectious.

Cancer itself is not hereditary, although a certain predisposition or susceptibility to cancer is apparently transmissible through inheritance. This does not signify that because one's parent or parents or other members of the family have suffered from cancer, cancer will necessarily appear in other persons of the same or succeeding generations.

The control of cancer, so far as this subject can be understood at the present time, depends upon the employment of measures of personal hygiene and certain preventive and curative measures, the success of which depends upon the intelligent cooperation of patient and physician.

Persons who have cancer must apply to competent physicians at a sufficiently early stage in the disease in order to have a fair chance of cure. This applies to all forms of cancer. In some forms early treatment affords the only possibility of cure.

Cancer in some parts of the body can be discovered in a very early stage, and if these cases are treated properly the prospect for a permanent cure is good.

The cure of cancer depends upon discovering the growth before it has done irreparable injury to a vital part of the body and before it has spread to other parts. Therefore, efforts should be made to improve the methods of diagnosis in these various locations and the treatment of the cancers so discovered.

The public must be taught the earliest danger signals of cancer which can be recognized by persons without a special knowledge of the subject and induced to seek competent medical attention when any of these indications are believed to be present.

Practitioners of medicine must keep abreast of the latest advances in the knowledge of cancer and learn signs of cancer in order to diagnose as many as possible of the cases of cancer which come to them.

Surgeons and radiologists must make constant progress in the refined methods of technic which are necessary for the diagnosis and proper treatment not only of ordinary cases but of the more obscure difficult ones.

There is much that medical men can do in the prevention of cancer, in the detection of early cases, in the referring of patients to institutions and physicians who can make the proper diagnosis and apply proper treatment, when the physicians themselves are unable to accomplish these results. The more efficient the family doctor is the more ready he is to share responsibility with a specialist.

Dentists can help in the control of cancer by informing themselves about advance in the known cases

of cancer of the buccal cavity, especially with relation to the irritations produced by teeth but the condition of the bone dental plates. They can also help by referring cases of cancer which they discover to physicians skilled in the treatment of cancer in this location. It may be doubted whether some dentists fully realize the help which can be obtained from X-ray photographs which reveal not only the state of the teeth but the conditions of the bone surrounding them.

Medical students should be taught about cancer by the aid of actual demonstration of cancer patients, and this to a sufficient extent to give them a good working knowledge of the subject.

The most reliable forms of treatment and, in fact, the only ones thus far justified by experience and observation depend upon surgery, radium and X-rays.

Emphasis should be placed upon the value of the dissemination of the definite, useful and practical knowledge about cancer, and this knowledge should not be confused nor hidden by what is merely theoretical and experimental.

Efforts towards the control of cancer should be made in two principal directions, the promotion of research in order to increase the existing knowledge of the subject, and the practical employment of the information which is at hand.

Even with our present knowledge many lives could be saved which are sacrificed to unnecessary delays.

A proposal by Claude Regaud, director of the Pasteur Laboratory of the Radium Institute, Paris, for the establishment of an international federation of cancer control societies and a bibliographic index was referred to the various organizations for study and further consideration.

THE FIRST INTERNATIONAL CONGRESS OF SOIL SCIENCE

In accordance with the decision of the Fourth International Conference of Soil Science that met in Rome in May, 1924, the First Congress of the International Association of Soil Science, then organized, will convene on June 13, 1927, in Washington, D. C. The congress will be followed by a field excursion to visit the various important soil belts in the country. Opportunity will also be given to the delegates to acquaint themselves with various agricultural industries, some of the leading agricultural experiment stations and in general with the agricultural resources of the United States.

The association is made up of the following six international commissions:

I. *Commission on Soil Physics*

Chairman—Dr. V. Novak, Chef de l'Institut Pedologique, Kvetna 19, Brno, Czechoslovakia.

II. *Commission on Soil Chemistry*

Chairman—Professor Dr. A. deSigmond, Technische Hochschule, Szent-Gallertter, 4, Budapest, Hungary.

III. *Commission on Soil Bacteriology*

Chairman—Professor Dr. Julius Stocklasa, Professor an der Böhmischen, Technischen Hochschule und Direktor der Staatlichen Versuchsstation, Vinohrady, Prague, Czechoslovakia.

IV. *Commission on Soil Fertility*

Chairman—Professor Dr. E. A. Mitscherlich, Pflanzenbau-Institute der Universitat, Tragheimerkirchenstrasse 83, Königsberg, Germany.

V. *Commission on Nomenclature, Classification and Cartography*

Chairman—Professor C. F. Marbut, Bureau of Soils, Department of Agriculture, Washington, D. C.

Sub-Commission on the preparation of the Cartography of Europe

Professor Dr. H. Stremme, Mineralogisch-Geologisch Institut der Technischen Hochschule, Neptunstrasse 14, Danzig, Germany.

VI. *Commission on the Application of Soil Science to Land Cultivation*

Chairman—Dr. J. Girsberger, Kultur-Ingenieur des Kantons Zürich, Kaspar Escherhaus, Zürich, Switzerland.

The American representatives of these commissions are:

I. Dr. C. Davis, Bureau of Soils, Washington, D. C.
II. Dr. M. M. McCool, East Lansing, Michigan.
III. Dr. S. A. Waksman, New Brunswick, N. J.
IV. Professor D. R. Hoagland, Berkeley, California.
V. Dr. C. F. Marbut, Bureau of Soils, Washington, D. C.
VI. Dr. S. H. McCrory, Bureau of Agricultural Engineering, Washington, D. C.

Each commission is now working on the preparation of its own program. Some of the sessions will be devoted to the congress as a whole or to combined meetings of more than one commission, while a number of sessions (5 to 8) will be devoted to the special sessions of each commission.

The program of each commission will consist of papers presented by invitation by outstanding investigators in the respective fields, and of papers presented by various workers in the different branches of soil science, by members or non-members of the association. Titles of the papers to be presented and brief abstracts in English, French and German should be sent on or before December 1, either to the respective chairman or to the American representative of the commission, where the paper is to be presented, or to the president of the association, who will have the paper forwarded to the chairman of the corresponding commission.

This congress will bring together in this country, for the first time in its history, all those that are in-

terested in the different problems of soil classification, soil analysis, fertilization and treatment, as well as the relation of the soil to plant growth. Extensive exhibits of various soil types (monolithic columns, in respective horizons) from Europe and America, apparatus used in soil analyses, of the soil microflora and microfauna, etc., will be held during the congress.

DR. J. G. LIPMAN,
President International Society of Soil Science, New Brunswick, N. J.
DR. D. J. HISSINK,
Secretary, Groningen, Holland

PARASITES IN CENTRAL AMERICAN TROPICS

UNEXPECTED findings concerning animal parasites in Central American countries are reported by Dr. Maurice C. Hall, chief of the zoological division of the Bureau of Animal Industry, who returned on September 15 from a research expedition in the tropics. In representing the United States Department of Agriculture, Dr. Hall made a survey of the animal-parasite situation in Panama, Nicaragua and Salvador. The expedition was organized by and directed by the Johns Hopkins School of Hygiene and Public Health and conducted under the auspices of the International Health Board of the Rockefeller Foundation. The staff included also Drs. Cort, Stoll, Sweet, Riley, Augustine and Brown. Dr. Cort was the director.

Besides gathering extensive information concerning parasites and parasitic diseases in the countries mentioned, the scientists brought back about 150 bottles of prevailing parasites, some of them apparently new and of economic and scientific importance.

"The trip has furnished a valuable background of tropical conditions as regards factors in parasitic development," according to Dr. Hall. "In the extent and nature of diseases of livestock caused by parasites in the countries visited, the findings were unexpected and reassuring in many respects. The range cattle of those countries proved to be practically free from gastro-intestinal parasites, and in many cases appeared to be entirely so. While there is an abundance of moisture and warmth in the tropics, things which themselves are favorable to parasites, the seasonal distribution of rain is highly unfavorable to parasite eggs and larvae.

"In the countries visited—Panama, Nicaragua, Salvador and Guatemala—there are from two to six months, as a rule, and more in exceptional seasons such as this year, when there is no rain whatever. In the absence of moisture the hot tropical sun has a desiccating effect which is fatal to parasite eggs and larvae and which must have a decided sterilizing action on bacteria. Furthermore, the rains themselves are torrential and in the mountainous countries must have a washing effect which serves to sweep worm eggs and larvae into the many water courses and out of contact with livestock. Finally, there is little overstocking on these ranges and a resulting lack of concentrated infection."

One important object of the expedition was to determine what tropical diseases are likely to be carried northward by shipments of livestock. The survey has given a satisfactory answer to that question.

Cattle in the countries visited suffer from ticks and tick fever. Tuberculosis appears to be rare among the range cattle; the bacterial diseases of importance were anthrax, blackleg and tetanus. In contrast to the relative freedom of range livestock from parasites, household animals in the countries visited showed fairly extensive infestation. Swine especially suffer from kidney worms which cause considerable loss of meat and lard. Another common swine parasite causes the disease known as swine measles or cysticercosis, due to bladderworms in the meat. These bladderworms are the larval stages of a large and dangerous human tapeworm.

The results of the expedition show that in shipping livestock from Central America to the United States the only diseases of livestock that appear to warrant serious consideration are tick fever, anthrax, blackleg and tetanus, though final conclusions depend on the identification of the parasites collected and also on further studies in Central America. Dr. Hall made his examinations of animal parasites largely at local abattoirs in collaboration with Dr. Augustine.

Revolutions in Nicaragua in May and August interfered considerably with the project on the study of drugs for the removal of worms in which the International Health Board was especially interested and in which Dr. Hall also collaborated. The most interesting development of this work was the discovery that almost 40 per cent. of the soldiers examined and treated by the scientists were infected by one of the dog and cat hookworms not known to be present in man in Central America. The new findings are an important aid to public-health work in the regions visited. The scientists collaborating in this project were Dr. D. L. Augustine, Dr. D. M. Malloy, Don Bernabe Rosales and Dr. Hall.

The trip resulted also in numerous other findings of a specialized and highly technical character, including the efficacy of several new drugs.

THE PORTO RICAN SCHOOL OF TROPICAL MEDICINE

THE School of Tropical Medicine of the University of Porto Rico, founded under the auspices of Colum-

bia University, was opened with formal ceremonies on September 22.

The school, a post-graduate institution, to be maintained jointly by the University of Porto Rico and Columbia University, officially greeted a Columbia delegation consisting of Stephen G. Williams, representing the trustees; Dean Frederick J. E. Woodbridge, representing the university, and Dean William Darrach, representing the College of Physicians and Surgeons. The delegation welcoming them included Dr. Robert A. Lambert, director of the school; Antonio R. Barcelo, president of the trustees of the University of Porto Rico and president of the Porto Rican Senate, and Chancellor Benner.

The principal addresses at the inauguration of the school were given by Horace M. Towner, governor of Porto Rico; Don Barcelo and Dean Darrach.

Associated with Dr. Lambert for the year 1926–27 is a group of thirty-seven professors, instructors and resident and visiting lecturers, eight on full time and the rest on part time. Among them are Dr. Donald H. Cook, from Columbia; Dr. William A. Hoffman, from the Johns Hopkins; Dr. Pedro N. Ortiz, from Boston, Commissioner of Sanitation and Health of Porto Rico; Dr. Antonio Fernos Isern, from Maryland; Dr. Luis G. Hernandez, from Michigan; Dr. George C. Payne, from the Johns Hopkins and the International Health Board of the Rockefeller Foundation; Dr. Bailey K. Ashford, and Dr. Earl B. McKinley and Dr. Calvin B. Coulter, both of Columbia.

Twenty-two courses are being offered in bacteriology, mycology, pathology, chemistry, medical zoology, public health and transmissible diseases, and tropical medicine and surgery.

THE ERIC KNIGHT JORDAN FELLOWSHIPS IN GEOLOGY

Dr. and Mrs. David Starr Jordan have lately established a fund for research fellowships to be known as the Eric Knight Jordan Research Fellowships in Geology. To the sum of $5,000 already turned over to Stanford University the founders expect to add later, and they cherish the hope that friends of their son as well as of themselves may in time make further contributions.

With this gift, two stipulations only are made:

First: that the name of Eric Knight Jordan shall be perpetuated in the foundation, it being believed that he gave promise of becoming a rare worker in geology, his chosen subject;

Second: that the principal sum be forever kept inviolate, only its earnings to be used for any purpose whatsoever.

In accepting the original gift on behalf of the university, President Wilbur made the following comment:

As years go on Eric Jordan's name will be a source of inspiration to many workers in his own field of geology, in which he had already achieved signal successes, although a young man, and in which he gave promise of a brilliant future. The conditions of the gift are, I think, the wisest I have yet seen in any scholarship or fellowship foundation because they permit sufficient elasticity to meet changing conditions.

Knowing that among Stanford men and women there are some who will be glad to join with Dr. and Mrs. Jordan in the purpose specified, we would call attention to this foundation for geological research in memory of a son of Stanford's first president.

James Perrin Smith,
Robert Van Vleck Anderson,
Leo George Hertlein

SCIENTIFIC NOTES AND NEWS

The University of Cambridge will commemorate on October 5 the tercentenary of the death of Francis Bacon. Dr. C. D. Broad will give an address and there will be a reception and dinner at Trinity College. Honorary degrees will be conferred upon Sir Ernest Rutherford and Professor William Holdsworth.

In connection with the celebration of the fiftieth anniversary of the founding of the Johns Hopkins University, a volume of the *Journal of Pharmacology and Experimental Therapeutics* will be issued in honor of Dr. John J. Abel, its founder, who has since 1891 been identified with the university. The volume contains forty articles filling about 550 pages. The contributors are all colleagues, friends or students of Dr. Abel, including among foreign men of science the late Arthur R. Cushny, David I. Macht, Hans H. Meyer, Carl Voegtlin, Archibald V. Hill, P. J. Hanzlik, E. M. K. Geiling and Paul D. Lamson.

The Russian Academy of Sciences is planning a celebration in honor of the twenty-fifth anniversary of Professor J. P. Pawlow's first announcement in regard to conditioned reflexes.

The Chicago Chapter of the English Speaking Union arranged a luncheon for Sir James Colquhoun Irvine on September 16.

Dr. Fritz Paneth, professor of inorganic chemistry at the University of Berlin, has been elected non-resident lecturer in chemistry at Cornell University for the coming term.

Professor V. H. Blackman, Professor F. G. Donnan and Professor F. A. Lindemann have been appointed by Order of Council dated August 20 to be members of the advisory council to the Committee of the Privy Council for Scientific and Industrial Research, in succession to members who have retired on the completion of their terms of office.

At Princeton University Dr. Karl T. Compton, professor of physics, and Dr. Howard C. Warren, professor of psychology, have leave of absence for the first half of the academic year; Dr. Einar Hille, associate professor of mathematics, has a full year's leave.

Major Harold P. Sheldon, fish and game commissioner of Vermont, has been appointed chief United States game warden to fill the vacancy caused by the resignation of George A. Lawyer.

Dr. Howard W. Haggard, assistant professor of applied physiology at Yale University, has been appointed on the editorial board of the *Journal of Personnel Research,* succeeding Dr. Alice Hamilton, assistant professor of industrial medicine at the Harvard Medical School.

George D. Scarseth has resigned from the position of assistant in soils at the Connecticut Agricultural Experiment Station, to take a position as soils expert for the United Fruit Company, with headquarters at Tela, Honduras. His place has been filled by H. G. M. Jacobson, formerly with the department of agronomy at the University of Arkansas.

Drs. Percy S. Pelouze and Frederick S. Schofield, of Philadelphia, have been awarded the Alvarenga prize by the College of Physicians of Philadelphia for an essay on research in urology.

Dr. Jacob Hoffman, of Philadelphia, has been awarded a year's research work in Berlin and Vienna for meritorious work during his internship at Mount Sinai Hospital.

The expedition to Greenland led by Professor William H. Hobbs, of the University of Michigan, has returned on the expedition's schooner, the *Guy S. Morrissey,* in the best of health. Among them are Professor George P. Putnam, of the U. S. Geological Survey, and Robert E. Peary, Jr., son of Admiral Peary, the polar explorer. The expedition, starting in July, was for the purpose of making preliminary surveys for the University of Michigan-Danish Government expedition of 1927. The *Morrissey* was piloted by its owner, Lieutenant Commander Robert A. Bartlett, who was skipper for Peary.

Dr. Aleš Hrdlička, of the U. S. National Museum, has returned from a summer in the field spent in making an archeological survey of Alaska in which he covered the major portion of the Yukon basin and of the coast from St. Michael and Nome to Barrow, north of the Arctic Circle. The expedition was under the auspices of the Bureau of American Ethnology, Smithsonian Institution, and its main object was to throw further light on the probable route by which primitive man first set foot on the American continent.

According to an Associated Press dispatch, Roy Chapman Andrews, explorer and archeologist, has arrived from China after an ineffectual attempt to penetrate into the Gobi Desert to discover possible human evidences that this desert is the "cradle of mankind." Dr. Andrews was halted at Peking by warring Chinese factions. A camel train of 150 animals and a large amount of supplies was sent into the desert to await his coming, but lost track of the train in the fighting around Peking and it is believed that it may have been annihilated by one of the bands of marauding irregulars. Dr. Andrews puts his loss of camels and supplies at $25,000.

Commander Donald MacMillan, the Arctic explorer, has announced plans for an expedition into the North next summer. He plans to establish a scientific station, from which research and study will be carried on for five years. Commander MacMillan will remain at the station for fifteen months, returning to civilization for fresh supplies. Five scientific men will be included in the expedition.

Museum News states that James P. Chapin, of the American Museum of Natural History, who went to East Africa early in the year in charge of the Ruwenzori-Kivu Expedition, with Messrs. De Witt L. Sage, son of Henry W. Sage, and Frank P. Mathews, son of Dr. Frank S. Mathews, reports that he is meeting with excellent results in his collection of material. The route which they planned was to enter East Africa at Mombasa, cross the highlands and then go through the Uganda to Lake Albert. Turning south in eastern Belgian Congo, they expected to investigate the fauna of Mt. Ruwenzori, of the highest volcanoes of the Kivu district, thence by way of Lake Tanganyika and the Upper Katanga to South Africa. The party arranged to spend about six months. They are collecting birds for habitat groups in the museum.

Dr. Eugene C. Tims, of the Louisiana Experiment Station, has returned from a trip to Spanish Honduras, where he spent a month making a survey of sugar cane diseases for the Cuyamel Fruit Company.

Dr. Rokuro Takano, chief of the bureau of public health of the Imperial Japanese Government, has recently arrived at New York to attend the fifth conference of the International Union against Tuberculosis held at Washington, D. C., from September 29 to October 2.

Professor Dr. Hatai, professor of biology in the Tohoku Imperial University, who has been in America delivering lectures in the Rockefeller Institute, has been entrusted with establishing a new biologic institute in Japan. He returned to Sendai last July to negotiate with the committee of the Saito Ho-on

Association for the donation of a site and for the building of the institute.

DR. EDOUARD RIST, of the Laënnec Hospital and Dispensary, Paris, will deliver an address at the City Club, on October 11, under the auspices of the Chicago Tuberculosis Institute with the cooperation of the Institute of Medicine; there will be a dinner at Grayling's in honor of Dr. Rist, preceding the address. Dr. Ernst Loewenstein, professor of experimental pathology, University of Vienna, will also be in Chicago, October 27, and will deliver an address.

THE trustees and staff of the Mount Sinai Hospital, New York, have announced that Professor Friedrich von Müller will deliver the Edward G. Janeway Lectures on October 1 and 2, on "The Nervous System and Internal Medicine."

DR. GEORGE I. ALDEN, a founder of the Norton Company of Worcester, Mass., the inventor of the Alden absorption dynamometer, and for twenty-eight years professor of mechanical engineering at the Worcester Polytechnic Institute, died on September 13, aged eighty-three years. By the will of Professor Alden a trust fund of $3,000,000 is established, to be used eventually for philanthropic and educational purposes.

DR. ARTHUR HENRY GLENNAN, formerly assistant surgeon general of the United States Public Health Service, died at Washington on September 27.

DR. AUGUSTE J. ROSSI, consulting chemist of the Titanium Alloy Manufacturing Company and the Titanium Pigment Company, Inc., of Niagara Falls, N. Y., died on September 19 at the age of eighty-seven years after being ill three days.

DR. EDWARD S. BREIDENBAUGH, professor emeritus in chemistry at Gettysburg College, died on September 5, aged seventy-seven years.

GEORGE K. ELLIOTT, chief chemist and metallurgist for the Lunkenheimer Company, Cincinnati, died on September 23, aged forty-five years.

DR. WILLIAM ROMAINE NEWBOLD, Seybert professor of moral philosophy at the University of Pennsylvania, died on September 26, aged sixty-one years.

DR. PAUL KEMMERER, of Vienna, recently appointed professor of biology in the University of Moscow, has died by suicide. He left his library to the University of Moscow and his body to the Vienna Anatomical School.

DR. F. W. GAMBLE, F.R.S., Mason professor of zoology in the University of Birmingham, died on September 7 at the age of fifty-seven years.

AT the close of the International Congress of Plant Sciences recently held at Cornell University, a western field trip was organized and conducted by Professor Geo. D. Fuller, of the University of Chicago, in order to permit some of the visiting botanists to see something of the vegetation of various portions of the United States. The itinerary included Salt Lake City, Utah, and vicinity, the Yellowstone and Rocky Mountain National Parks, the environs of Fort Collins, Colorado, and the sand dune region of Lake Michigan. Among those participating in the excursion were Dr. John Briquet, Botanical Institute, Geneva, Switzerland; Dr. A. B. Rendle, curator of botany, British Museum, London; Professor Richard Wettstein, University of Vienna; Professor and Mrs. A. Maximow, Agricultural Institute, Leningrad; Professor and Mrs. Karel Domin, Charles University, Prague; Dr. Eduard Rübel, Geobotanic Institute, Zürich; Professor Al. Borza, Cluj University, Roumania; Count A. Marcello, Venice, Italy; Dr. Carl Skottsberg, Botanic Garden, Gothenberg, Sweden; Professor von Slogteren, phytopathologist, Bulb District, Lisse, Holland; Professor W. Szafer, University of Cracow, Poland; Professor T. W. Woodhead, Technical College, Huddersfield, England; Dr. Ferd. Comte, Forestmeister, Yverdon, Switzerland; Professor F. Kotowski, Warsaw, Poland; Dr. Miss Marie Löhnis, Scheveningen, Holland; Professor K. Wise, Posen, Poland, and Mr. Carleton Rea, Worcester, England.

THE Rockefeller Institute for Medical Research was host on September 25 to a group of foreign delegates who attended the recent cancer symposium held by the American Society for the Control of Cancer at Lake Mohonk, N. Y. The party arrived at the institute at 11:30 A. M. and went first to the laboratories of Dr. Alexis Carrel for an inspection of his department and a demonstration of "The New Method for the Study of Malignant Tumors." Dr. Wade H. Brown gave a brief talk and demonstration on "Malignant Disease in the Rabbit." Following luncheon, Dr. James B. Murphy demonstrated in his laboratory some recent work on the experimental production and transmission of tar sarcoma in chickens. Among the group attending these demonstrations were the following: Drs. Henri Hartmann, Claude Regaud and Gustave Roussy, of Paris; Dr. Léon Bèrard, of Lyons; Dr. T. Marie, of Toulouse; Dr. Albert Reverdin, of Geneva; Dr. J. Maisin, of Louvain; Dr. William DeVries, of Amsterdam; Dr. H. T. Deelman, of Groningen, and Professor Maud Slye, of Chicago.

Nature reports the following awards for the year 1926–27 made by the Salters' Institute of Industrial Chemistry and approved by the Court of the Company: Fellowships have been renewed to—Mr. H. S.

Pink, University College, Nottingham, and University of Oxford, at the Massachusetts Institute of Technology; Mr. V. E. Yarsley, University of Birmingham, at the Polytechnic, Zürich; Dr. R. Campbell, Armstrong College, Newcastle-upon-Tyne, and University of Oxford, at the department of chemical engineering, University College, London. Fellowships have also been awarded to—Mr. E. A. Bevan, East London College, University of London; Mr. R. M. Deanesly, University of Oxford; Mr. R. Edgeworth-Johnstone, College of Technology, University of Manchester; Mr. H. B. Spalding, University of Oxford. The Salters' Institute has also awarded fifty-one grants-in-aid to young men employed in chemical works to facilitate their further studies.

UNIVERSITY AND EDUCATIONAL NOTES

AMONG the announcements of gifts at the recent convocation of the University of Chicago was the sum of a million dollars given by Douglas Smith for medical research.

BY the will of the late Sir John Williams, Bart., president of the University College and of the National Library of Wales, who died on May 24, the residue of the property, which will amount to nearly £100,000, is bequeathed to the two institutions of which he was president.

DR. RALPH D. HETZEL, for nine years president of the University of New Hampshire, has been elected president of Pennsylvania State College. He succeeds Dr. John M. Thomas, who resigned about a year ago to become president of Rutgers University.

DR. ROBERT MULLIKEN, formerly of Harvard University, has been appointed assistant professor in physics at New York University. Dr. Lloyd B. Ham, in charge of the elementary laboratories, has been promoted to the rank of assistant professor in the same department.

R. B. MOORE has resigned his position as general manager of the Dorr Company to become head of the department of chemistry at Purdue University.

AFTER a year spent in study at the University of Chicago, Dr. E. H. Johnson has resumed his work as professor of physics in Kenyon College. Dr. John Coulson, formerly of the Westinghouse Electric Company and of the faculty of the University of Pittsburgh, has been appointed assistant professor of physics. With the opening of the current academic year the department of physics will be housed in the new Samuel Mather Science Hall, the gift of Mr. H. G. Dalton, of Cleveland.

AFTER six years of service with the Michigan Department of Health, Dr. George H. Ramsey has become associate professor of epidemiology in the School of Hygiene and Public Health, the Johns Hopkins University.

LEON S. WARD, Ph.D. (Wisconsin), has been appointed associate professor of chemistry at the Michigan College of Mines, Houghton.

APPOINTMENTS have been made in the department of zoology at Syracuse University as follows: Julian D. Corrington, Ph.D. (Cornell, '25), assistant professor of zoology; M. Thelma Holmes, M.A. (Syracuse, '26), instructor in zoology; Norman E. Phillips, A.B. (Allegheny, '16), instructor in zoology.

DR. NOEL J. G. SMITH, of the department of botany of the University of Aberdeen, has been appointed professor of botany in the Rhodes University College.

DISCUSSION

THE DISCOVERY OF THE INSECTICIDAL PROPERTY OF CARBON DISULPHIDE

SINCE the sixth decade of the last century, a period of about seventy years, carbon disulphide has been our chief reliance as a fumigant for killing injurious insects in stored grain and in the soil. Attempts to replace it with something better have failed. It has been used in large quantities and the benefits that have resulted have been great. It is therefore worth while to know to whom we are indebted for the discovery of the insecticidal property of this chemical.

W. E. Hinds's "Carbon Bisulphide as an Insecticide"[1] is our standard reference on the use of this material as a fumigant. Dr. Hinds says (page 8), "So far as the writer can learn, the first use of carbon bisulphide as an insecticide was made in 1856 and 1857 by M. Doyère, who demonstrated that a small amount of the liquid poured into a pit of corn or barley would kill all the weevils and their eggs…." W. H. Goodwin, in an article on "Carbon Bisulphid and its Use for Grain Fumigation,"[2] also gives credit to M. Doyère for introducing the material as an insect fumigant. The evidence that follows indicates that Doyère discovered the insecticidal use of carbon disulphide independently, but that his work was anticipated by another investigator, M. Garreau.

In July, 1854, Garreau published[3] the results of experiments with various compounds against grain

[1] U. S. Dept. Agr., Farmers' Bull. 145, 1902. (A revision, Farmers' Bull. 799, 1917, omits the historical review of the subject.)

[2] Mo. Bul. Ohio Agr. Exp. Sta., v. 1, no. 3, 1916, pp. 86–90.

[3] Archives de l'Agriculture du Nord de la France (Lille), t. 2, pp. 195–198.

weevils, and he reported that *sulfure de carbone* was far more effective than any of the other agents tested. It acted quickly, small dosages were sufficient to kill the insects and the odor of the fumigant disappeared rapidly from the grain upon aëration.

Doyère's account of his discovery of the value of *sulfure de carbone* as an insecticide was published in May, 1857,[4] and described the results of experiments carried on at Algiers. His work with anesthetics against stored-grain insects was inspired, he wrote, by similar experiments made with benzine vapor by M. Milne-Edwards. Doyère did not mention Garreau's investigation.

At the October 12 meeting of the Academy at Paris,[5] a communication from Garreau claimed priority in the discovery. Garreau stated that in 1854 he had sent to Doyère the result of his experiments, but that the latter apparently had neglected to read the published report of the work.

Doyère replied at the November 2 meeting of the Academy,[6] emphatically denying that he had received any communication from Garreau or that he had known of Garreau's work with *sulfure de carbone*.

During November, 1857, Garreau published[7] a second paper on *sulfure de carbone* in which he gave detailed directions for applying it and for avoiding explosions. The matter of priority was discussed during the same month at a meeting held on the 11th by the Agricultural Assembly of the District of Lille.[8] A member stated that most journals had given credit for the discovery to Doyère; and that, at about the time of Doyère's announcement, the invention had been patented by M. Millon, a chemist, but that the honor rightly belonged to Garreau. The assembly then decided to send to the minister of war the published evidence in support of Garreau's claim.

Louis-Michel-François Doyère (1811–1863)[9] devoted a number of years to studies on the conservation of grain. He published on several subjects, including milk, ensilage and economic entomology. In 1854 he received a prize for the invention of a machine for killing grain-infesting insects by mechanical shock. During the greater part of his life he was a teacher, serving at the Lyceum of Henry IV as professor of natural history, as professor of zoology applied to agriculture at the Agronomic Institute of Versailles, and as professor at the Central School of Arts and Manufacturers.

Dr. Lazare Garreau (1812–1892)[10] started as a military pharmacist and served several years in Algeria. From 1844 to 1855 he was professor of materia medica at the Lille Military Hospital of Instruction, resigning to devote himself entirely to the teaching of chemistry and pharmacy at the Preparatory School of Medicine and Pharmacy. For the ten years preceding his retirement in 1886 Garreau was professor of medical chemistry and toxicology in the Faculty of Medicine at Lille. He published on a variety of subjects and was especially interested in the respiration of plants.

PEREZ SIMMONS
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A NEW LONGEVITY RECORD

DURING the course of the accumulatoin of data for the study of the rôle of the thyroid apparatus in growth and differential organ development in the albino rat, it happened that the control animal of one of the litter groups died. In this group there was a stunted little thyroidless male rat which had been thyroidectomized at thirty days of age on the sixth of November, 1923. Since, with the loss of the control, the test animal was obviously of no use in the investigation as organized, it was allowed to live on in order to see just how long a rat would live minus its thyroid gland. One year passed, two years passed and still the little runt, never weighing over fifty or sixty grams, played and ate heartily in the cage with its brothers. It never showed any signs of illness or lethargy. Its coat of hair was slightly ruffled, as is usual for thyroidless rats, and its eyes were prominent, but otherwise it seemed healthy and normal. Not knowing its real age one would have taken it to be a rat of about fifty days. Time went on until the thirteenth of July, 1926, when our specimen was found dead in the cage at the ripe age of two years and nine months, having lived two years and eight months without a thyroid gland. This was proven by careful post-mortem examination. The noteworthy thing is that this animal lived to almost the maximum age assumed to be the natural span of life for the species by Donaldson; *i.e.*, three years. And a rat of three years, even under the best of conditions, is hard to get, and if he lives that long he is an old, old rat, practically equivalent to a man of ninety years. On Donaldson's idea my rat lived without his thyroid until he was as old as a man of

[4] C. R. Hebd. Séances Acad. Sci. (Paris), 1st semester, pp. 993–996.

[5] *Ibid.*, 2nd semester, 1857, pp. 533–534.

[6] *Ibid.*, pp. 690–691.

[7] Archives de l'Agriculture du Nord de la France (Lille), Ser. 2, t. 1, pp. 369–372.

[8] *Ibid.*, p. 382.

[9] Larousse, P., Grand Dictionnaire Universel du XIX[e] Siècle, 1865.

[10] Journal de Pharmacie et de Chimie, 5th Series, a. 27, p. 109, 1893.

eighty-two or thereabouts. And this is a new longevity record. It should be noted that this rat received no thyroid substance in the diet or in any other way, from the time the thyroid was removed up to the time of his death.

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THE VENOM OF NEW BORN PIT VIPERS

PROFESSOR ALBERT M. REESE, in his notes on "The Venom of New Born Copperheads,"[1] solicits information upon the age at which pit vipers acquire their power of injecting venom.

Professor George E. Beyer, in his "Contributions on the Life Histories of Certain Snakes,"[2] gives two very personal observations in connection with the poisonous qualities of the young of these snakes.

In speaking of a one-day-old water moccasin, *Agkistrodon piscivorus,* he makes the following statement: "To test their poisonous qualities I permitted one of them to bite me, but outside of the peculiar penetrating sensation attendant upon all venomous snake bites, and not unlike a bee sting, I did not feel other results."

In the same paper, speaking of *Sistrurus miliarius* he shows how he was mistaken in rating the toxic qualities of very young venomous snakes. During the noonday hour of August 20, 1894, exactly eight days after the birth of a brood of the young ground rattlers, he picked up one and presented the first joint of the little finger of his right hand for a bite. The snake bit with a vengeance, producing a momentary sensation resembling the sting of a bee; at the same time a lightning-like pain seemed to shoot up to the shoulder. In a few minutes the local pain extended to the second joint, the wound became discolored and edema set in. Increased swelling and pain gradually extended to the wrist and forearm. He carefully describes the symptoms which continued to be serious until half past eleven, when he went to bed. By daybreak the swelling had extended well down the right side and upwards, involving the same side of the face. The pectoral region was extremely painful. After 10 A. M. the reaction set in and the symptoms gradually subsided, but an uncomfortable feeling throughout the entire system remained up to thirty-six hours, and the inflammation did not disappear entirely until after three days. He concludes by stating that no remedy had been applied from beginning to end.

The evidence at hand seems conclusive that the venom glands of pit vipers are completely functional eight days after birth, but it seems doubtful that they secrete venom to any extent until some time after the first day.

PERCY VIOSCA, JR.

NEW ORLEANS, LA.

[1] SCIENCE, April 2, 1926.

[2] *The American Naturalist,* Vol. XXXII, No. 373, January, 1898.

SYMBOLS FOR MUTATIONS IN MICE

IN an attempt to standardize the symbols used for the mutations in mice, the Mouse Club, at its meeting in New Haven on December 27, 1925, agreed on the following symbols.

The following factors were recognized as orthodox and the symbols appearing herewith were voted into the code.

Agouti series:
A^y—dominant yellow, A^w—White Bellied Agouti, A—Agouti, a—non-agouti.

Albino series:
C—Full color, c^{ch}—Chinchilla dilution, c^d—Detlefsen extreme dilution, c—albinism.

B—black, b—brown.

D—dark coat, d—dilute coat (blue dilution).

H—Normal head, h—haemoragic head.

P—Dark eye, p—pink eye.

R—Rodded or normal retinae, r—rodless retinae.

S—Self coat dominant to recessive spotting, s—recessive spotting.

S^E—Normal size ears, s^e—short ears.

T—Normal length tail, t—short tail (tailless).

V—Normal walking or running, v—waltzing.

W—Black-eyed-white, w—recessive self allelomorph.

The following characters were passed as non-orthodox and will not be accepted until more work has been done upon them, but the symbols here recorded have been reserved tentatively for them.

F—Normal foot, f—haemoragic foot.

J—Normal jaw, j—haemoragic jaw.

K—Normal tail, k—kinky tail.

DP—Normal pupil, dp—dilate pupil.

Strong's carcinoma factors for immunity, A^{st}—1 factor, B^{st}—2 factor, C^{st}—factor were discussed, but no decision was reached concerning their status.

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EDUCATION IN MANITOBA

THE June 4th issue of SCIENCE contains a review of A. H. R. Buller's Researches on Fungi, Vol. III, the review concluding with the following statement: "Manitoba seems very remote even to an American, yet when an English trained botanist makes it his home and turns out such stimulating and exact work we realize more fully than ever that the man rather

than the environment counts the most." Manitoba has more pupils in high school and college, in proportion to the population, than any other province of Canada, excepting Ontario, and the University of Manitoba has a student body of over 2,400 with 1,500 additional in attendance on short courses and summer school, under the instruction of 195 professors and lecturers, and situated in a city of over 200,000. May I inquire why the reviewer chooses such an environment to point his platitudinous conclusion?

J. W. Shipley

QUOTATIONS

WAR ON DISEASE

In his Annual Report for 1925 on "The State of the Public Health," Sir George Newman strikes a new note. He is not concerned with the rival claims of those who believe in a state medical service and of those who oppose this service, because he sees that a truly national effort against disease, in which health officers and doctors and citizens will all take part, is the inevitable solution of present difficulties. Nor does he attempt to place any one of these partners before the other. They are equal; they are, and must remain, free; yet each, for the sake of all, must consent to give something both of personal liberty and of independence of action. This, it is contended, is made plain when the practical circumstances of the effort against disease are considered. Sickness is never a single event. Even a cold in the head is a problem of preventive medicine, a research problem, a problem in epidemiology and in therapy, and a problem of domestic and of personal hygiene. And what is true of a cold in the head is true also of every industrial accident, of each of the ailments which threaten child life and the lives of mothers, of cancer and tuberculosis and heart disease. The connection between the new regulations for the Insurance Medical Service, the rules governing the use of preservatives in food, and the plans to control atmospheric pollution may not be immediately apparent, but it is real and of vital importance. Last year, for example, in England and Wales there was lost to the nation among the insured population only, and excluding the loss due to sickness, for which sickness or disablement benefit is not payable, a total of twenty-five million weeks' work (480,770 years), or the equivalent of twelve months' work of nearly half a million persons. It is actually possible to-day to ascribe a great part of this loss to causes over which only the citizen himself has any control, to causes, that is to say, which lie beyond the scope of the medical profession.

This is obvious when the nature of the ailments responsible for the loss is considered. Common colds, bronchitis and bronchial and nasal catarrh stand easily first as causes of disablement among the working population. Sir George Newman produces important evidence to show that these ailments and also pneumonia are more prevalent and more fatal in the industrial north and north-west than in the south, and he is able, to some extent, to exclude the weather as the sole or even the chief cause of this difference. The purity of the atmosphere is probably the chief determining factor. In other words, smoke abatement —a matter for engineers and householders—is a department of preventive medicine. It is, moreover, a department of preventive medicine in which every doctor and every citizen, to say nothing of every employer of labor and every approved society, has a vital interest. Diseases of digestion, again, rank very high as robbers of health and of industry. These may seem to lie outside the sphere of preventive medicine altogether; but this is a narrow view, as those realize who have followed the controversy on the chemical purity of foodstuffs.

Nor can the research worker be relegated much longer to the obscurity of his laboratory. He too is needed in every home into which disease has been able to penetrate. Last year heart diseases ranked first among the "killing ailments." The cause of them is but imperfectly understood. Cancer had third place. It is manifest that in the fight with these two most deadly enemies the resources of prevention and of cure are largely unavailing until new knowledge has been obtained. Sir George Newman is therefore entitled to his vision of the "mutual aid and interdependence which should obtain between improved environment (including housing and industrial conditions), the care and nurture of the body, and the social life of the community." He is unquestionably right when he demands a closer partnership between all those who are engaged in, or who are interested in, the war against disease. The great voluntary hospitals have set in the past a conspicuous example of the spirit of cooperation between different types of workers, and for that reason alone deserve all the support which on this "Hospital Saturday" a generous and deeply interested public is likely to give them. The war on disease, curiously enough, is likely in the near future slightly to change its character. Owing to the fact that the birth-rate and the death-rate have fallen in this country side by side, the average age of the population has increased. The death-rate can not, in the nature of things, fall much further, but there is no sort of assurance that the fall in the birth-rate will not continue. Consequently old age may for a time go on increasing numerically at the expense of youth. The effect must be to make youth more valuable in an economic sense and to make the

burden of preventible disease more and more intolerable. As the army of active workers diminishes, its working power must be conserved if disaster is to be avoided. Longer working lives and stronger working lives can alone discount the loss of numbers of working lives.—The London *Times*.

RESOLUTIONS CONCERNING GEOPHYSICS

The following resolutions were adopted by the American Geophysical Union during its Seventh Annual Meeting, April 30, 1926.

Resolution on the Variation of Latitude

(Submitted by Section of Geodesy)

Whereas, The problem of the variation of latitude concerns not only astronomy, but also geophysics in its broadest sense, as is evidenced by the appointment by the International Astronomical Union and the International Geodetic and Geophysical Union of a joint committee consisting of astronomers, geodesists and geophysicists to confer with and advise the officers of the organizations conducting the present latitude-variation stations on an international cooperative plan, and

Whereas, The accepted method of studying this problem is by the operation of a chain of latitude stations on the same parallel, all using a common program of observations, and

Whereas, The great extent of the United States in longitude suggests that its contribution to this important piece of international work should include more than the maintenance of the present single station at Ukiah, California, and

Whereas, The original number of latitude-variation stations on the thirty-ninth parallel of latitude has been reduced from six (three of which were in the United States) to three, a number found to be too small for the adequate study of the many elements that are now known to enter into this problem, and

Whereas, Of the abandoned latitude stations that at Gaithersburg, Maryland, would be the easiest to reestablish and the most useful, and

Whereas, The importance of reoccupying this station is recognized by experts and has been urged many times in the unanimous reports of committees of the American Section of the International Astronomical Union, duly adopted by the section, and

Whereas, The International Astronomical Union, meeting at Cambridge, England, in 1925, has urged the Director of the United States Coast and Geodetic Survey to endeavor to secure the reoccupation of Gaithersburg; therefore, be it

Resolved, That the American Geophysical Union strongly recommends that observations be resumed at the Gaithersburg latitude station, preferably under the direction of the United States Coast and Geodetic Survey, which now supervises the work at the latitude station at Ukiah, California; and, be it further

Resolved, That copies of this resolution be sent to the President of the United States, to the Secretary of Commerce, to the Director of the United States Coast and Geodetic Survey, to the President of the National Academy of Sciences, to the President of the American Astronomical Society, to the President of the Geological Society of America and to the President of the Seismological Society of America.

Resolution Concerning the Topographic Mapping of the United States

(Submitted by Section of Geodesy)

Whereas, Accurate knowledge of the geographic positions, elevations and configurations of the ground is essential to the efficient carrying on of geophysical investigations, and

Whereas, The results of these investigations have great scientific and practical value; therefore, be it

Resolved, That the American Geophysical Union heartily endorses the plan of the United States Government to complete the topographic mapping of this country in the near future; and, be it further

Resolved, That copies of this resolution be sent to the President of the United States, the President of the Senate and the Speaker of the House of Representatives.

Resolution on Greater Uniformity in Pyrheliometric Measurements

(Submitted by Section of Meteorology)

Whereas, In the interest of convenience to investigators, greater uniformity in pyrheliometric measurements is desirable; therefore, be it

Resolved, That the Meteorological Section (c) of the International Union of Geodesy and Geophysics be requested (1) to authorize its Commission on Solar Radiation to encourage in every way possible the maintenance of an international network of pyrheliometric stations for obtaining directly comparable measurements of the intensity of solar energy, (2) to include as many high-level stations as practicable in this network and (3) to provide that especially at high-level stations attention be given to the measurement of the ultra-violet radiation and the ozone content of the atmosphere, and

Resolved, That the above-named commission be authorized to cooperate with the Commission on Solar Radiation of the International Meteorological Committee in arranging for the intercomparison of sub-standard pyrheliometers for use in different countries, in preparing a program to be recommended for daily observations and in securing prompt publication of monthly summaries of results, and

Resolved, Further, that a copy of these resolutions be sent to the General Secretary of the International Geodetic and Geophysical Union (Colonel H. G. Lyons) and to the Chairman of the Committee of the International Research Council for the Study of Solar and Terrestrial Relationships (Dr. S. Chapman, Imperial College of Science, London, England).

RESOLUTION ON SOLAR-RADIATION STATIONS AND RESULTS

(Submitted by Section of Meteorology)

WHEREAS, In view of the probable early completion of arrangements in southwest Africa for determining the constant of solar radiation and the availability thereafter of such data from three stations, one each in North America, South America and southwest Africa, and

WHEREAS, It is claimed that the provisional values of these determinations are an aid in weather forecasting; therefore, be it

Resolved, That the American Geophysical Union expresses its great pleasure and satisfaction in the purpose of the Smithsonian Institution and the National Geographic Society to maintain the stations above-mentioned for a period of at least four years; and, be it further

Resolved, That the Astrophysical Observatory of the Smithsonian Institution be, and hereby is, requested to make the data of these stations available at the earliest practicable moment to all organized weather services, and

Resolved, Further, that a copy of these resolutions be sent to the Secretary of the International Meteorological Committee (Th. Hesselberg, Oslo, Norway), for transmission to the various governmental weather services adhering to that Committee with a request for cooperation in the attempt to correlate data of solar radiation with terrestrial weather, and a copy also to the General Secretary of the International Geodetic and Geophysical Union (Colonel H. G. Lyons).

RESOLUTION ON GRAVITY AT SEA[1]

(Endorsed by sections of Geodesy and Seismology for favorable consideration)

WHEREAS, A method for the determination of gravity at sea with an accuracy comparable to that obtainable on land has been perfected by Dr. F. A. Vening Meinesz, of the Dutch Geodetic Commission, and has been successfully used by him on two voyages on a submarine, one from Holland to Java by way of the Suez Canal and the other from Holland to the Suez Canal, and the method will again be used by Dr. Meinesz during the present summer on a voyage from Holland to Java by way of the Panama Canal; and,

WHEREAS, The deficiency in gravity observations over the ocean areas and inland seas is retarding geological and geophysical studies; and,

WHEREAS, The desirability of making gravity observations at sea has been recognized by the Section of Geodesy of the International Geodetic and Geophysical Union which, by suitable resolutions, has urged all nations having navies to make observations similar to those made by Dr. Meinesz; therefore, be it

Resolved, That the Division of Geology and Geography of the National Research Council of the United States commends in the highest terms the Dutch Geodetic Commission and the Dutch Navy for making it possible for Dr. Meinesz to carry on his gravity observations at sea and expresses the hope that every maritime nation may find it possible to supplement the magnificent work of Dr. Meinesz by making additional gravity determinations at sea, especially near its own coasts. We especially commend this work to the Navy Department and to the Coast and Geodetic Survey of the United States of America; and, be it further

Resolved, That a copy of this resolution be sent to the President of the United States, to the Secretary of State, to Dr. F. A. Vening Meinesz, to Dr. J. J. A. Mueller, President of the Dutch Geodetic Commission, to the Admiral of the Dutch Navy, to the Secretary of the United States Navy, to the Secretary of Commerce, and to the Director of the United States Coast and Geodetic Survey.

[1] Adopted by Division of Geology and Geography at its annual meeting of April 24, 1926, and approved by Division of Foreign Relations of National Research Council on April 25, 1926.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A PRESERVING FLUID FOR GREEN PLANTS

No matter how highly the commercial preparation of laboratory specimens may be developed, there will always be botanists to whom the collection and preservation of their own material will have its own attraction. Most of the current methods, however, of preparing macroscopic—and, to some extent, microscopic—material leave much to be desired. Certainly the uniformly bleached condition of the preserved specimens offered for study in many botanical courses is not an incentive to interested work. As a possible solution of this problem the results of certain experiments begun last summer at the Marine Biological Laboratory and continued through the year at the University of Wisconsin are here tentatively offered for consideration.

The preparation of museum specimens of pathological plant material by the copper acetate method is not new. The process is, however, both tedious and unpleasant. In order to simplify it, it was necessary first to find a general fixing fluid fairly adequate for preserving most plant forms. With this as a basis of experimentation it was next important to find a way to color the plastids so that they should appear as natural as possible.

The fixing fluid finally employed is a modification of that used by the supply department of the Marine Biological Laboratory for preserving zoological specimens. As a coloring agent copper acetate was first used but proved too blue for all plants except the blue-green algae. Copper chloride gave somewhat better results, but it was not until uranium nitrate was employed with it that effects somewhat approximating natural conditions were finally obtained.

The complete formula is as follows:

50 per cent. alcohol	90	cc.
Commercial formalin	5	cc.
Glycerine	2.5	cc.
Glacial acetic acid	2.5	cc.
Copper chloride	10	gm.
Uranium nitrate	1.5	gm.

No particular care is necessary in making up this solution, as the salts dissolve fairly readily in the colorless fluid formed by the first four reagents. Incidentally, it may be mentioned that this colorless solution has been found useful in preserving several of the larger basidiomycetes, providing they were preserved fresh and carefully cleaned of adhering earth and other foreign materials. Other uses of this combination will undoubtedly suggest themselves. For the blue-green algae ten grams of copper acetate has been substituted for the copper chloride and uranium nitrate. Yellowish green plant forms permit of a reduction of the amount of copper chloride by half. This is particularly applicable to forms like Spirogyra, young corn plants, the young needle clusters of the larch and the like.

For general laboratory use materials are merely dropped into this fluid and stored until needed. Some delicate forms are ready for study in forty-eight hours. Generally speaking, however, the color change in most plants is less rapid, and from three to ten days are necessary for complete preservation. The gymnosperms do not readily yield to this treatment. The only success thus far obtained has been with very young and delicate needles.

Herbarium mounts made from forms preserved in this fluid have withstood fading, although exposed on a south window, for the last eight months and give evidence of continuing to hold their color.

Although some experiments have been made in that direction, no variation of this fluid has been found which will preserve the color of flowers for more than a very few days. The anthocyan pigments seem to be too unstable to produce satisfactory results.

Our present lack of definite knowledge as to the exact nature of chlorophyll prevents an adequate explanation of the process here described. From the behavior of specimens in this solution it may be supposed that there is possibly a reorganization of the chlorophyll molecule and the formation of copper and uranium derivatives in the chloroplasts.

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A BINOCULAR MAGNIFIER FOR THE DETERMINATION OF OPAQUE MINERALS

The use of reflected light has found a definite place in the identification and genesis of opaque minerals, but so far as the writer can ascertain, determination is made with a petrographic or metallographic microscope. While this equipment is satisfactory for laboratory study, there are certain valid objections raised to its use by the man in the field.

The adjustment of the vertical illuminator requires considerable time and care, and such an adjustment must be made when the microscope is taken from its case for use, and when oblique illumination is desired. The polished surface of the specimen must be normal to the vertical light rays and if this condition is changed, as it frequently is during the washing and rubbing operations, the surface must again be made normal to the light rays. In addition, the field of vision is limited and on account of the short working distance, it is usually necessary to remove the specimen each time a reaction is completed and the operator frequently has difficulty in locating the exact spot for reexamination. If these conditions were remedied, considerable time could be saved during the determination.

The microchemical tests are by far the most important means of identification, yet these tests are often obscured because the drop of reagent stands with a distinctly convex surface. Only those light rays striking the central portion of the drop are reflected into the microscope tube, thus cutting down the observable area and obscuring the reaction.

Field instruments must be compact, portable and of sturdy construction. An additional important feature is simplicity of operation. Neither the petrographic nor the metallographic microscope fulfils these requirements and their use is therefore impractical for the man in the field.

A series of experiments with a binocular magnifier was conducted in an effort to find a practical method of obviating these difficulties. A Leitz binocular magnifier with a BSM-A type prism body, mounted on a sliding column, was used, which with 15x oculars gives a magnification of forty-five diameters. The binocular was clamped to the table and the specimen, mounted with its polished surface roughly horizontal to keep the reagents from running off, was placed on the table in front of it. In order to obtain the most brilliant illumination, the prism body was tilted until the light from the polished surface was reflected into the binocular tube. This feature eliminates any attachment for illumination.

In operation, it is not necessary to have the surface of the specimen exactly horizontal, as the specimen can be shifted and the prism body quickly tilted to receive the reflected rays of light from

the polished surface. The binocular has a long working distance and therefore a large field of vision, which permits two and sometimes three reactions to be observed simultaneously. This feature considerably reduces the time required for determination. The long working distance also allows greater freedom of movement between the objectives and the specimen and permits speedier determination.

The portion of the specimen covered by the reagents is clearly visible, in contrast to the obscured vision under the microscope, for with oblique daylight illumination the rays approach from all angles instead of one direction as in vertical illumination. The formation of a tarnish is more readily noted in oblique than in vertical illumination. Effervescence along cracks and fractures is more clearly observed because the reagent drop does not obscure the points of effervescence.

The binocular magnifier is well made, sturdy and compact. It fits rigidly in its case and is portable. The cost of such an outfit is from $100 to $125 as compared with $350 to $400 for a petrographic microscope. Aside from its use with opaque minerals, the binocular is exceedingly valuable for field study of fossils and rocks.

The chief disadvantages in the uses of the binocular are the inability to use magnifications greater than 45x and the absence of polarizing attachments.

In conclusion, the use of the binocular magnifier eliminates many of the objectionable features of the petrographic microscope for field study, beside increasing the speed and accuracy of many of the observations.

The writer has not had the opportunity of using one of the Leitz pocket microscopes, but is of the opinion that it could serve in place of the more expensive binocular magnifier. In this case, it is recommended that oblique daylight be used for illumination, following the system outlined for the binocular magnifier.

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THE USE OF PLASTICINE MODELS IN TEACHING MITOSIS

DURING the past few years we have used the following method of teaching mitosis to students of elementary botany. Instead of making the customary series of drawings from prepared slides, the modeling wax is substituted for the pencil. Upon small cards about three by four inches, with a slightly roughened surface, outline drawings are made by the student of the cell wall, nuclear membrane, spindle fibers, etc., according to the stage being studied. On this diagram the chromatin granules, nucleoli or chromosomes, modeled from the wax, are placed. A little pressure is sufficient to make the wax adhere to the card.

Our students take great interest in making these models. They grasp the idea more vividly than when only drawings are made and are quick to shift the cards in their proper sequence. Less time is required in making a series of models than in making complete drawings. The models will stand ordinary handling and may be made somewhat permanent by coating with shellac.

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SPECIAL ARTICLES

THE RING METHOD FOR THE DETERMINATION OF SURFACE TENSION

THE methods most often used for the determination of surface tension are known as the drop weight and the ring method, respectively. Of these the former is at present much the more exact, and by careful manipulation and the use of the proper functional relation may be made to give correct results to within 0.1 per cent. New technique recently developed in this laboratory makes this method even more precise.

While an approximate theory of the ring method has been developed by Cantor,[1] Tichanowsky,[2] MacDougall,[3] and others, the theory holds well only for rings of dimensions which are usually not employed in practice, so that the uncertainty which remains in the results amounts to 12 per cent. or even more. On account of the incompleteness of the theory most workers adopt as the basis of their calculations an equation entirely analogous to that used with the capillary height method, or they consider that the total pull on the ring (P) is represented by

$$P = Mg = 4\pi Rp = 4\pi R\gamma \qquad (1)$$

The significance of the symbols is represented below:

γ = surface tension in dynes per centimeter.
a = square root of the capillary constant.
M = weight in grams used in balancing the maximum pull of the film.
P = total maximum pull on the ring in dynes.
p = P divided by $4\pi R$.
R = radius of the ring measured to the center of the circular wire.
r = radius of the circular cross-section of the wire.

[1] Cantor, *Wied. Ann.* 47, 399–423 (1892).
[2] Tichanowsky, *Physikal. Z.* Various papers, 1923–25.
[3] MacDougall, SCIENCE, n. s., 62, 290 (Sept. 25, 1925).

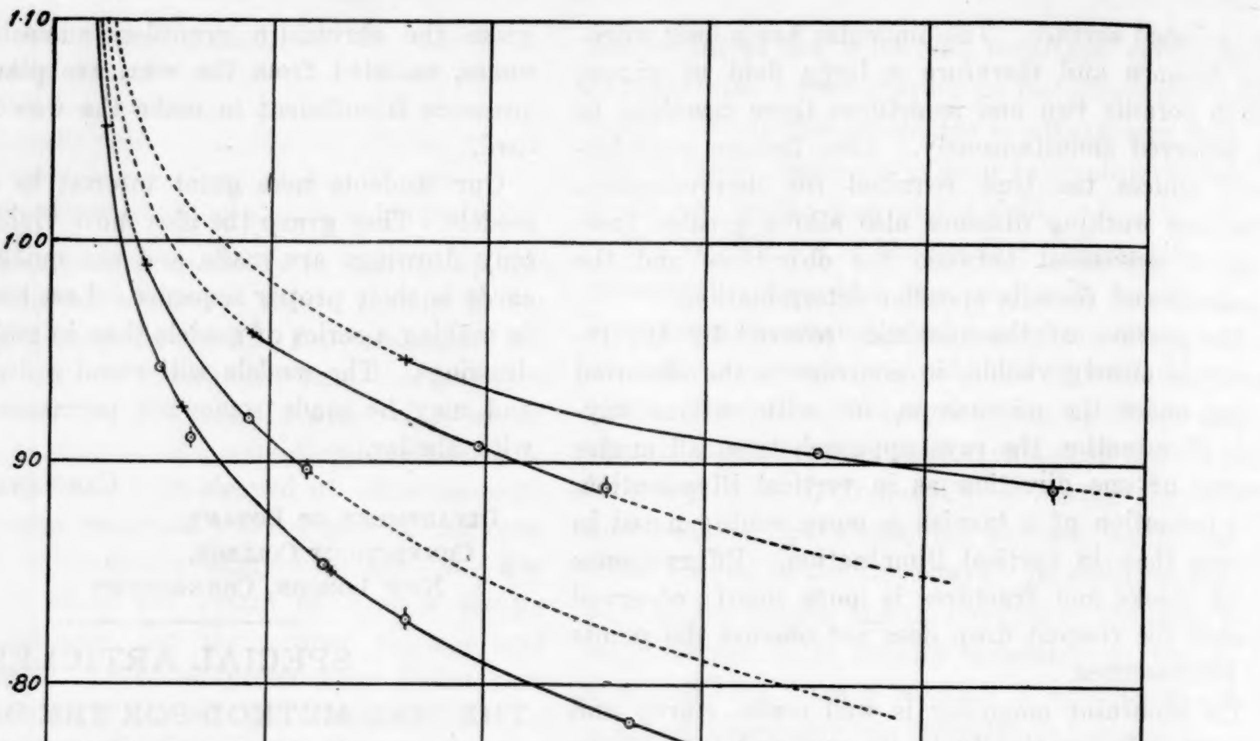

FIG. 1

The values of $\frac{R}{r}$ for the curves in this figure beginning with the bottom curve, are : 29.5, 40.2, 59.1 and 78.5.

D = density of the liquid.

V = volume of liquid upheld by the pull of the ring $= \frac{M}{D}$

g = gravitational constant in dynes per gram.

h = the height above the bottom of the drop at which the pressure in the column of liquid equals that in the vapor at the bottom of the drop ("pressure height").

It will be seen later that the surface tension as calculated by the use of this equation may vary by 25 per cent. or even more from the correct value, which is given by the simple equation

$$\gamma = \frac{Mg}{4\pi R} \cdot F = \frac{PF}{4\pi R} \qquad (2)$$

Here F is a correction factor which may be determined simply by experiment, and might be found by the use of theory if the differential equations of the surface could be integrated in the general case.

The simple equation of Cantor and MacDougall

$$\gamma = p - r\sqrt{2pDg} + \left(\frac{\pi + 3}{4}\right) r^2 Dg$$

gives results with water which are 12 per cent. low if R = .47 and r = .03 cm, but if R is raised to 1.26 the deviation is reduced to 2.5 per cent. Thus, as those who derived the equation indicate, it is more accurate for rings in which R is large. It is apparent that F may be found experimentally, since

$$F = \frac{\gamma}{p} \qquad (3)$$

The writers have obtained preliminary values of this correction factor (F) to within ± 1 per cent. by comparing the surface tensions (γ) of various liquids as determined by the capillary height and drop weight methods with the values of the maximum pull on different rings as determined both by the tensiometer of du Noüy[4] in its latest form, and by a chainomatic balance. Of these the former is the more convenient, while the latter is obviously somewhat more accurate and allows the use of large rings without adjustment of the system.

Cantor, Tichanowski, MacDougall, Johlin[5] and others have pointed out that the value of p varies considerably both with the radius of the ring and that of the wire. The present paper exhibits the nature of these variations.

Fig. 1 shows that the correction factor (F) is most simply represented as a function of $\frac{R}{a}$ and of $\frac{R}{r}$. To obtain the lowest curve in the figure three

[4] *Journal of Gen. Physiology*, 1, 521 (1918–19).

[5] Johlin, SCIENCE, 64, 93 (July 23, 1926).

rings of radii (R) 0.47, 0.77 and 1.18 cm were used, but the ratio of the radius of the ring to that of the wire was kept constant $\left(\frac{R}{r}=29.5\right)$.

Thus, while the values of the correction factor are represented by a surface this gives a line if $\frac{R}{r}$ is kept constant. This is the most important relation discovered in the present work. With any specific liquid p increases with R (rapidly if $\frac{R}{a}$ is small) provided r is kept constant, and p also increases with r provided R is kept constant. If $\frac{R}{r}$ is kept constant p increases with $\frac{R}{a}$ or $\frac{R^3}{V}$. According to the principle of similitude the shape of a meniscus depends upon $\frac{R}{a}\left(\text{or } \frac{R^3}{V}\right)$ alone and not at all upon its size. The shape of a drop hanging from a sharp tip with circular horizontal face is also the same and independent of the size, provided $\frac{R}{a}$ and $\frac{R}{h}$, where h is the "pressure height," are kept constant. By the proper manipulation the value of $\frac{R}{h}$ is very simply regulated by the experimenter so that the shape of the drop just before detachment depends on $\frac{R}{a}\left(\text{or } \frac{R^3}{V}\right)$ entirely and not at all on its size. According to the principle of similitude the shape of the surface of maximum pull should depend on $\frac{R}{a}$ and $\frac{R}{r}$ alone. Thus if $\frac{R}{a}$ is kept constant the shape of the surface remains the same if the radius of the ring is increased, provided the radius of the wire is increased in the same ratio.

To obtain an unknown surface tension the maximum pull (M) in grams on the ring is obtained experimentally. From this the value of p is obtained from

$$p=\frac{Mg}{4\pi R}$$

The volume of liquid (V) held above the plane surface of the liquid, which corresponds with the maximum pull is

$$V=\frac{M}{D}$$

$$\frac{R^3}{V}=\frac{R^3D}{M}$$

The correction factor (F) for this value of $\frac{R^3}{V}$ and the proper value of $\frac{R}{r}$ is found on the graph (Fig. 1), and the surface tension is obtained from the equation

$$\gamma = p.\frac{V}{p}=p.F$$

Certain experimental precautions are essential if a moderately high degree of precision is desired:

(1) It is important to cover the liquid since evaporation may cool the surface more than the body of the liquid, and in the case of colloidal and other solutions the nature of the surface film may be modified. For this purpose an inverted glass funnel may be used.

(2) The liquid and the vapor above it should be buried beneath the surface of a thermostat. This may be done if a specially designed vessel is used.

(3) In the case of water or of aqueous solutions this special vessel should be designed in such a way that the surface may be renewed or swept by a bar of glass.

(4) The support for this vessel should be entirely independent of that of the thermostat, and during the period of measurement the liquid of the thermostat should not be stirred, since surface waves may be set up in the surface being measured.

(5) The area of the surface should be large, since otherwise corrections for the curvature for the meniscus in the vessel are essential.

It may be well to point out here that certain precautions which have been supposed by some writers to be essential for this method are inherent in the nature of either an ordinary or a torsion balance and have nothing to do with the method of detachment of the ring; thus it is sometimes stated that the force required for detaching the ring from the liquid should be applied on the liquid and not on the ring. Now it is apparent that this is impossible, since the force must be applied on both. What is meant is that the balance must be kept at its zero position. Actually it may be preferable to raise the balance rather than to lower the liquid, since lowering the liquid is apt to set up surface waves. However, raising the balance may transmit momentum to its beam, so what is important is that the mechanism used for its purpose shall operate with extreme smoothness.

An important but simple modification was made in the du Noüy tensiometer, the end of the beam farthest from the torsion wire was lengthened by the insertion of a light, rigid, pointed wire. Opposite this, a fixed (but adjustable) point of the same sharpness was set. A small telescope set a foot distant made

it possible to determine the "zero" of the torsion balance with greatly increased ease and precision.

The left hand of the chainomatic balance was replaced by a long weighted wire, which exactly balances the right-hand pan and extends downward below the balance case. A thermostat was not used for the work reported in this preliminary article, but the temperature was determined and corrections were made for variations in temperature. It may be mentioned that if the liquid is to be lowered from the ring, the coarse and fine adjustments of a microscope stand may be employed.

This work is being continued by one of the writers under more exactly controlled conditions, with a greater number of rings and of liquids and it is hoped that an accuracy of ± 0.1 per cent. may be attained, though this may not be possible with ordinary precautions.

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THE CHROMOSOMES OF RODENTS[1]

DURING the present year students working under my direction have made careful studies of the chromosomes of the house mouse, the albino rat and the guinea pig. The purpose of this note is to give the results of these studies briefly. Detailed papers will appear later under the names of the students who have carried out the work.


1

2


3


4


5

House mouse (worked out by Elizabeth Cox). A number of investigators have reported the haploid or reduced chromosome number of both male and female mice as twenty, but diploid counts have not been made. Numerous counts made on dividing spermatogonia show that the diploid number for the male is forty chromosomes. Figure 1 is a typical spermatogonial plate. The haploid number is twenty. The sex chromosomes are of the X-Y type, the Y being somewhat larger than the smallest pair of autosomes. In the first maturation division the X and Y appear first as joined (Fig. 2) but they later segregate to opposite poles. As a result the sperm are dimorphic as regards the sex chromosomes.

Albino rat (worked out by Irene Kehoe). The diploid chromosome number for the rat has been given by Allen ('18)[2] as thirty-seven, a number based largely on first spermatocyte counts. It has been found that spermatogonia of albino rats (Wistar stock) show forty-two chromosomes (Fig. 3). This count has been confirmed by a careful study of the somatic (amnion) chromosomes of a number of male and female embryos. The haploid number is twenty-one. Observations on the sex chromosomes have not been completed, but apparently they are of the X-Y type, similar to those found in the mouse (Fig. 2).

Guinea pig (worked out by Bessie League). Stevens ('11)[3] reported that there were approximately fifty-six chromosomes in this form, but recently Harmon and Root ('25) have reported thirty-eight as the diploid number.[4] Counts made at this laboratory indicate that the diploid number is between sixty and sixty-four (Fig. 4) and the haploid number is thirty (Fig. 5). Sex chromosomes have not been identified. The guinea pig has proved of especial interest because in prophases of spermatogonia the chromosome number is lower than in the equatorial plate stages. This suggests that the high number is a late acquisition for this form and has resulted from a breaking up of a smaller number of elements. It seems possible that different strains of guinea pigs may differ in the degree to which this fragmentation occurs and as a result that the chromosome number may vary in well-fixed material.

Four rodents have been carefully studied at this laboratory with chromosome number determinations as follows for males: rabbit forty-four chromosomes, albino rat forty-two chromosomes, house mouse forty chromosomes, and guinea pig about sixty chromosomes.

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[1] Contribution No. 203 of the Department of Zoology, University of Texas. These investigations have been aided by grants from the Committee for Research on Sex Problems of the National Research Council under the direction of the writer.

[2] Allen, Ezra, 1918, *Journ. Morph.*, Vol. 31.

[3] Stevens, N. M., 1911, *Biol. Bull.*, Vol. 21.

[4] See Abstracts of Christmas Meetings, Amer. Soc. Zool., at New Haven, 1925. Also Biol. Bull., vol. 51.